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DYNAMO-ELECTRIC MACHINES.

IN our other columns will be found a long report on the Edison-Hopkinson dynamo. Dr. Hopkinson has recently re-designed the Edison machine, and his modifications have resulted in the production of current sufficient to sustain three times the number of lamps that were formerly fed by a given machine. It must not be understood by this that the electrical efficiency of the new machines is any greater than that of the better known types, but what Dr. Hopkinson has accomplished may be clearly stated in a few words. By altering the proportions and disposition of the field-magnets the magnetic field has been greatly strengthened, and now a machine of the size which was formerly employed for 60 lamps will keep up 200, but, of course, with a corresponding increase of motive power. We think that the Edison Company has every reason to be elated at the success of the Edison system in England already, and with the valuable improvements effected by Dr. Hopkinson this success will certainly continue. Although the electrical efficiency of the improved machine is a trifle lower than the results given by some Edison dynamos tested in America, yet the results agree so well that for practical purposes they may be said to be identical. Under these circumstances we should expect a slight economy in using a single machine (A) of three times the capacity of a machine (B), in the place of three (B) machines; for, although the motive-power necessary for producing a given amount of current might be the same in both instances, yet, in the former case we have only one armature to drive and the friction of one machine to overcome.

The long and elaborate report referred to will certainly interest our more scientific readers, and Dr. Hopkinson may, in this instance, be congratulated in achieving a more substantial result than in another case in which his name figured in connection with a dynamo-electric machine.

TELEPHONE COMPANIES AND PROPERTY OWNERS.

RECENTLY a curious case was disposed of in the City of London Court by Mr. Commissioner Kerr. This gentleman, by the way, has long been noted for his eccentricities, but whether he was within his rights in the decision to which we shall now refer, can best be determined by our legal readers. It appears that an independent gentleman sued the United Telephone Company for damages for erecting posts and wires, on his land, without leave. The case will be found fully reported in our "Notes" columns, so we will call attention to one point only. Mr. Commissioner Kerr holds that according to English law an owner is entitled to the enjoyment of everything between his property and the heavens, and that the plaintiff therefore would have been justified in cutting the wires. Not only this, but had any of the severed wires caused the death of any passers by, the Commissioner holds that the plaintiff would have been held guiltless of manslaughter; and, considering the multiplicity of telephone wires, it was desirable that the public should know that such was the fact. This decision will no doubt be more welcome to maliciously inclined property owners than to the public, for the latter has sufficient danger already to encounter in the streets of London. But surely the eccentric Commissioner must have mistaken English law.

A property owner acting under such a decision would consider he had a right to build upon his land to any height, but we know that many restrictions are placed upon such a line of conduct, as, for instance, the interference with ancient lights.

As the matter is one of great importance to the public, we should be glad to know the opinions of some of our legal friends on the point decided *pro tem.* by Mr. Commissioner Kerr.

ELECTRO-MOTORS AND THEIR GOVERNMENT.

By Professors W. E. AYRTON, F.R.S., and JOHN PERRY, M.E.

(*Continued from p.* 181.)

CONNECTION BETWEEN BACK ELECTROMOTIVE FORCE AND SPEED OF A MOTOR.

Considering the somewhat complicated way in which the fields due respectively to the armature and to the field-magnet are distorted, each by the iron core of the other, and that both fields are carried round through a certain angle by the motion, it is very striking to find even in our motors, where not merely the field-magnet field but also the armature field is made intentionally important, that, whatever be the lead of the brushes, the back electromotive force is proportional to the speed if the currents passing through the motor be kept constant. Thus, for example, with our normal size motor here on the table, with six positions of the brushes differing successively by 15 degrees, we obtain as the result of a large number of experiments,

$$\begin{aligned}
e &= n \times 0{\cdot}01193 \text{ for } \phi = +\ 9^\circ \\
e &= n \times 0{\cdot}01160 \text{ ,, } \phi = -\ 6^\circ \\
e &= n \times 0{\cdot}01110 \text{ ,, } \phi = -\ 21^\circ \\
e &= n \times 0{\cdot}01050 \text{ ,, } \phi = -\ 36^\circ \\
e &= n \times 0{\cdot}00901 \text{ ,, } \phi = -\ 51^\circ \\
e &= n \times 0{\cdot}00589 \text{ ,, } \phi = -\ 66^\circ
\end{aligned}$$

where n is the number of revolutions per minute.

The e here mentioned is obtained by subtracting C, R_0 from the potential difference established at the motor terminals. To obtain the true back electromotive force, v, we ought, as already explained, to subtract a term, $\mathrm{C}\ n\ p$, in consequence of the increase of the resistance arising from the rotation. Hence, for a constant current, if e is, as we find, proportional to the speed, so ought v to be. It follows, then, that although γ increases with the speed, and although the expression given on page 155 for the true back electromotive force increases with γ, still it is a constant for a constant value of C and ϕ. Now, for a constant current, v may be expressed as a function of n multiplied by a function of ϕ and n, or

$$f(n) \times f^1(\phi, n)\,;$$

and v we have proved is independent of n if ϕ is constant. Hence when n is altered, $f(n)$ must vary in inverse proportion to $f^1(\phi, n)$.

If we consider the above-mentioned values of e, and divide them by n, we obtain a series of constants for each lead; or, if we plot the values of e for a fixed current and for a fixed speed, we obtain the form of $f^1(\phi, n)$, since v and e for a fixed current and a fixed speed only differ by a constant. This we have done in fig. 29 for a speed of 2,000 revolutions per minute, in which case the following were the corresponding values of e and ϕ:—

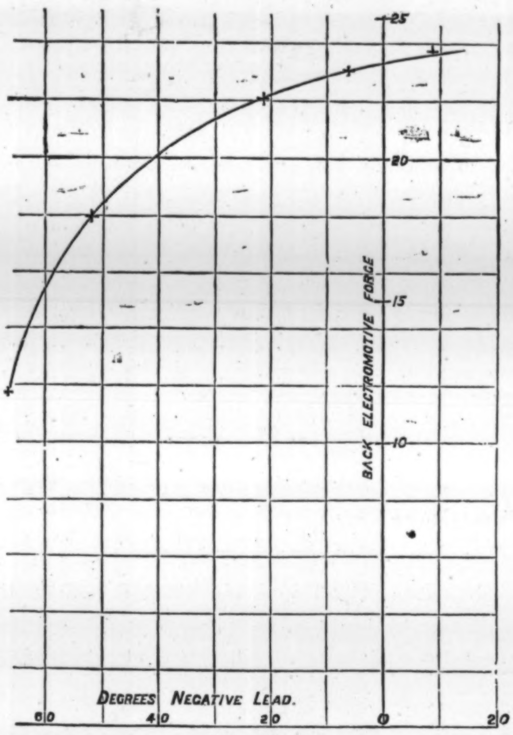

FIG. 29.

e.	ϕ.
23·85	+ 9°
23·2	− 6
22·21	− 21
21·01	− 36
18·02	− 56
11·78	− 66

It is interesting here to notice the fact on which we have already laid great stress, namely, that a back lead, although it may cause less sparking, does so at the expense of the back electromotive force, which we observe diminishes steadily as the lead becomes more and more negative.

We have already seen that

$$v = n\,\chi(\phi, \mathrm{C}),$$

and

$$\mathrm{C\,V} = \mathrm{C}^2(\mathrm{R}_0 + np) + \mathrm{C}\,v;$$

also that

$$\mathrm{C}\,v = \mathrm{P} + nr + \psi,$$

where P is the power utilised, $n\,r$ the power wasted in material friction, and ψ the power wasted in magnetic friction and friction with the air. Hence the efficiency of the motor E

$$= \frac{n\,\mathrm{C}\,\chi(\phi, \mathrm{C}) - nr - \psi}{\mathrm{C}^2(\mathrm{R}_0 + np) + n\,\mathrm{C}\,\chi(\phi, \mathrm{C})},$$

so that if ϕ and C are constants

$$\mathrm{E} = \frac{\mathrm{A} - \dfrac{\psi}{n}}{\dfrac{\mathrm{B}}{n} + \mathrm{D}}$$

But we find that, whatever the lead of the brushes may be, there is a certain speed for every lead beyond which not only does the efficiency diminish, but it diminishes proportionately to the increase of speed; that is, as soon as $\frac{\mathrm{B}}{n}$ becomes insignificant in comparison with D, we have E following a law of the shape

$$\mathrm{E} = a - b\,n.$$

Hence we see that ψ must be proportional to the square of n—that is, the waste of power due to magnetic friction and the friction of the air must be proportional to the square of the speed, or the frictional force is proportional to the speed, the ordinary rule for fluid friction.

The following sets of numbers obtained from experiments with one of our normal size motors, weighing 36 lbs., before making the improvements described further on, are examples of the results from which we have deduced the law just stated:—

PERCENTAGE EFFICIENCY AT THE FOLLOWING SPEED.

LEAD.	REVOLUTIONS PER MINUTE.							
	600	800	1,000	1,200	1,400	1,600	1,800	2,000
$\phi = -66°$	25·8	29·0	29·9	30·3	29·4	28·1	26·5	24·6
$\phi = -51°$	26·2	28·6	29·5	28·6	26·6	23·4	21·4	18·0
$\phi = -36°$	24·9	26·0	26·3	25·6	24·2	22·0	18·9	14·8
$\phi = -21°$	26·2	27·1	26·0	23·6	20·8	16·2	11·6	6·0
$\phi = -6°$	22·6	25·4	24·0	21·2	17·0	12·0	5·8	—
$\phi = 9°$	20·3	20·6	19·8	17·9	14·0	8·0	0·9	—
$\phi = 24°$	17·4	17·4	16·6	14·7	12·0	6·9	2·6	—
$\phi = 39°$	12·9	13·4	10·2	8·9	4·2	—	—	—

The two great sources of loss of power in dynamos and motors are—

1. Loss by electric resistance.
2. Loss by magnetic friction.

In small motors we find that when the first of these is great the second is small, and when the second is great the first is small. This is to be expected; for when the magnetic field for a given current is made very strong, by means of pieces of iron protruding from the armature, the motor becomes a powerful one, only a small amount of power being wasted in heat due to wire resistance. But this very protrusion of pieces of iron produces necessarily discontinuity in the magnetic field, so that, although the average field set up by the armature through which the field-magnet moves is a constant relatively to the field-magnet, it undergoes fluctuations, and so causes heat in the iron of the field-magnet, in addition to the heat set up in the iron of the armature by the constant reversals of the current in it. Thus we find in our motors, where the resultant magnetic field due to the armature and field magnets is very powerful, that it is magnetic friction that we have to strive to diminish, whereas in motors made on the Gramme or Siemens principle it is the heating due to resistance that is so much in excess. Similarly in the De Meritens machine, a complete set of experiments on which is about to be given, the magnetic friction is comparatively small.

This being the case, we use these observations to illustrate how any machine may be taken up by a student, and the law for its efficiency and power determined without his binding himself down to any theory of the loss due to magnetic friction. But when taken up in this way, even the experiments on the De Meritens machine show the loss due to magnetic friction is proportional to the square of the speed.

This object alone would not have been a sufficient reason for putting before the members, such a large number of results of experiments, but we give these numbers mainly because we are not aware that any such complete set of observations, so carefully made, on a motor has yet been published, and as there are many persons who are anxious to investigate this important question of motors, and who have no opportunity of making observations for themselves, it has appeared to us desirable that accurate data should be at their disposal.

EXPERIMENTS ON DE MERITENS' MOTOR, MONDAY, 26th FEBRUARY, 1883, AND THE FOLLOWING DAYS.

Speed.	Current in ampères.	Potential difference at the motor terminals in volts.	W_1	W_2	$W_1 - W_2$	Horse-power put in.	Horse-power taken out.	Efficiency E	Resistance R_0	$\frac{V}{n}$	e	$\frac{e}{n}$	REMARKS.
1,504	8·4	28·1	1·6	4	2·4	·318	·162	·51	...	·0186	...	...	W1,W2, and W1—W2 are in kilogrammes.
1,796	7·5	30·4	2·4	4	1·6	·304	·129	·42	...	·0169	...	...	Lead of the brushes the same throughout all the experiments.
1,432	9·8	29·8	5	8	3	·392	·192	·49	...	·0208	...	...	
1,368	10·0	29·8	6	9	3	·399	·184	·46	...	·0217	...	...	
1,260	11·1	28·6	7·4	11	3·6	·428	·203	·47	...	·0226	...	...	
1,290	10·2	28·6	7	10	3	·390	·173	·44	...	·0221	...	...	
1,552	10·7	32·5	7	10	3	·464	·208	·45	...	·0209	...	...	
1,302	12·2	31·5	8	12	4	·516	·233	·45	...	·0241	...	...	
1,188	13·9	32·9	10	15	5	·614	·266	·43	...	·0267	...	...	
1,208	13·9	32·2	10	15	5	·602	·271	·45	...	·0266	...	...	
1,152	14·6	31·2	10	16	6	·611	·310	·51	...	·0270	...	...	
1,048	15·3	30·7	10	17	7	·632	·329	·52	...	·0292	...	...	
1,008	16·4	31·0	12	19	7	·681	·316	·46	...	·0307	...	...	
1,030	15·0	30·5	14·2	20	5·8	·613	·268	·44	...	·0296	...	...	
572	13·1	19·8	13	18	5	·349	·128	·37	...	·0363	...	...	
612	12·3	19·8	14	18·2	4·2	·327	·115	·35	...	·0323	...	...	
706	13·1	22·9	14	19	5	·403	·158	·39	...	·0324	...	...	
932	13·9	26·4	14	19	5	·490	·200	·42	...	·0283	...	...	
2,266	12·7	47·1	10	14	4	·802	·406	·51	...	·0208	...	...	
2,066	14·4	46·5	11	16	5	·899	·463	·51	...	·0210	...	...	
1,986	14·1	45·3	11	16	5	·855	·445	·52	...	·0228	...	...	
2,006	12·3	42·2	12	16	4	·695	·359	·52	...	·0210	...	...	
1,932	12·7	41·5	14	18	4	·707	·346	·49	...	·0214	...	...	
1,085	10·2	23·8	10	13	3	·327	·146	·45	...	·0219	...	...	
1,844	15·6	44·0	13	18	5	·916	·413	·45	...	·0238	30·9	·0168	To take this speed used counter.
1,850	15·1	45·6	13	18	5	·91	·4	·44	...	·0248	32·9	·0177	Now used the indicator to take the speed with.
1,940	14·7	44·9	13	18	5	·883	·435	·49	...	·0231	32·5	·0167	
1,820	14·7	44·7	13	18	5	·87	·39	·46	...	·0246	32·4	·0178	
1,930	14·3	43·0	13	18	5	·81	·42	·53	...	·0228	31·0	·0160	
2,400	14·7	61·8	13	18	5	1·19	·52	·44	...	·0257	49·4	·0206	
2,947	15·6	61·5	13	18	5	1·25	·64	·52	...	·0208	48·4	·0164	
2,904	15·6	60·9	13	18	5	1·21	·63	·52	...	·0209	47·8	·0164	
1,660	10·1	32·5	11	14	3	·42	·21	·51	...	·0195	24·0	·0145	
1,600	10·6	32·5	11	14	3	·44	·20	·47	...	·0203	23·6	·0147	
1,840	24·4	55·7	20	30	10	1·77	·804	·45	...	·0302	35·2	·0192	
1,920	23·3	55·4	20	30	10	1·68	·84	·50	...	·0288	35·8	·0187	
1,520	23·0	47·0	20	30	10	1·41	·664	·47	...	·0309	27·7	·0182	
1,520	22·9	47·0	20	30	10	1·4	·664	·47	...	·0309	27·7	·0182	
1,090	23·2	38·9	20	30	10	1·17	·477	·41	...	·0357	19·4	·0178	

Speed.	Current in ampères.	Potential difference at the motor terminals in volts.	W_1	W_2	$W_1 - W_2$	Horse-power put in.	Horse-power taken out.	Efficiency E	Resistance R_0	$\frac{V}{n}$	e	$\frac{e}{n}$	REMARKS.
1,120	22·6	39·2	20	30	10	1·15	·49	·43	...	·0352	10·2	·0180	
600	22·5	30·7	20	30	10	·895	.262	·29	...	·0514	11·8	·0201	
580	22·5	30·4	20	30	10	·887	·254	·29	...	·0524	11·5	·0198	
335	22·4	24·1	20	30	10	·695	·146	·21	...	·0719	5·3	·0154	
330	22·5	24·4	20	30	10	·706	·145	·20	...	·0739	5·5	·0169	
320	22·5	24·4	20	30	10	·706	·14	·20	...	·0765	5·5	·0171	Took these with the counter.
2,412	24·2	67·3	20	30	10	2·12	1·05	·50	...	·0279	46·9	·0194	
2,936	24·6	65·8	20	30	10	2·11	1·28	·61	...	·0258	45·1	·0154	
2,032	24·2	63·8	20	30	10	2·01	·89	·44	...	·0313	43·5	·0213	
2,700	25·4	71·6	20	30	10	2·38	1·18	·50	...	·0262	50·3	·0186	
1,000	7·6	20·3	3	5	2	·198	·087	·44	...	·0203	13·9	·0139	
1,000	7·5	20·0	3	5	2	·193	·087	·45	...	·0200	13·7	·0137	
720	7·6	16·0	3	5	2	·154	·063	·41	...	·022	9·6	·0134	
440	7·7	12·2	3	5	2	·118	·038	·33	...	·0277	5·7	·013	
940	7·4	18·0	3	5	2	·169	·082	·49	...	·0191	11·8	·0125	
1,200	7·8	22·3	3	5	2	·223	·105	·47	...	·0185	15·7	·0131	
1,450	8·0	26·1	3	5	2	·27	·127	·47	...	·018	19·4	·0133	
1,650	8·2	29·6	3	5	2	·313	·144	·46	...	·0179	22·7	·0137	
1,850	8·3	33·1	3	5	2	·358	·162	·45	...	·0178	26·1	·0141	
2,200	8·6	36·8	3	5	2	·425	·197	·46	...	·0167	29·6	·0134	
1,800	8·3	33·1	3	5	2	·361	·157	·44	...	·0183	26·1	·0145	
2,142	8·4	36·0	3	5	2	·393	·187	·47	...	·0168	28·9	·0135	
2,460	8·6	40·0	3	5	2	·447	·215	·48	...	·0162	32·8	·0133	
2,656	8·8	44·1	3	5	2	·507	·231	·46	...	·0188	36·7	·0138	
2,820	9·0	47·0	3	5	2	·551	·246	·45	...	·0166	39·4	·0139	
3,200	9·0	50·4	3	5	2	·592	·28	·47	...	·0157	42·8	·0133	
3,400	9·3	52·8	2	4	2	·641	·297	·46	...	·0158	45·1	·0132	
3,500	9·3	56·2	2	4	2	·686	·306	·45	...	·0160	48·4	·0138	
480	11·0	15·7	6	10	4	·230	·086	·39	...	·0327	6·6	·013	
484	11·4	15·7	6	10	4	·239	·087	·37	...	·0324	6·1	·0127	
795	11·5	21·4	6	10	4	·330	·142	·44	...	·0269	11·7	·0148	
620	10·8	20·3	6	10	4	·294	·111	·39	...	·0327	11·2	·0181	
700	11·1	20·0	6	10	4	·297	·125	·43	...	·0285	10·7	·0153	
724	10·8	20·0	6	10	4	·290	·129	·45	...	·0276	10·9	·0151	
1,000	10·8	23·5	6	10	4	·341	·179	·54	...	·0235	14·4	·0144	
1,000	10·8	23·5	6	10	4	·341	·179	·54	...	·0235	14·4	·0144	
860	10·6	21·4	6	10	4	·306	·154	·51	...	·0248	12·5	·0145	
1,320	11·4	29·3	6	10	4	·447	·237	·53	...	·0222	19·7	·0149	
...	32·0	27·3	...	...	...	...	...	...	·852	...	...	...	
1,165	10·8	27·3	6	10	4	·395	·209	·53	...	·0234	18·2	·0156	
1,400	11·4	31·0	6	10	4	·474	·250	·53	...	·0221	21·4	·0152	
...	33·2	29·0	...	...	...	...	...	...	·874	...	...	...	
1,560	11·4	32·8	6	10	4	·500	·280	·56	...	·021	24·5	·0154	
1,575	12·3	34·8	8	12	4	·574	·282	·57	...	·0221	26·2	·0155	
1,690	11·6	35·9	8	12	4	·561	·303	·55	...	·0212	28·3	·0167	
...	15·2	12·2	...	...	...	...	...	...	...	...	...	...	
1,780	11·9	38·3	8	12	4	·610	·319	·52	...	·0215	28·5	·016	
1,870	12·1	37·0	8	12	4	·660	·335	·51	...	·0192	26·8	·0143	
1,964	12·5	41·8	8	12	4	·697	·352	·50	...	·0218	31·3	·0159	

EXPERIMENTS ON DE MERITENS' MOTOR, MONDAY, 26th FEBRUARY, 1883, AND THE FOLLOWING DAYS.—*Continued.*

Speed.	Current in ampères.	Potential difference at the motor terminals in volts.	W_1	W_2	W_1-W_2	Horse-power put in.	Horse-power taken out.	Efficiency E	Resistance R_o	$\frac{V}{n}$	e	$\frac{e}{n}$	REMARKS.
2,064	12·5	43·8	8	12	4	·731	·37	·51	...	·0212	33·3	·0161	
2,260	12·3	45·2	8	12	4	·746	·405	·54	...	·02	34·9	·0154	
...	18·8	15·1	...	...	...	...	...	...	·803	...	...	...	
2,356	12·3	47·3	8	12	4	·779	·422	·54	...	·02	37	·0157	
2,428	12·5	49·3	8	12	4	·823	·435	·53	...	·0203	38·8	·0159	
2,536	12·5	50·5	8	12	4	·843	·454	·54	...	·0199	40	·0157	
2,716	12·5	52·8	8	12	4	·881	·487	·55	...	·0195	42·3	·0155	
...	19·3	15·1	...	...	...	...	...	...	·782	...	...	...	
2,804	12·7	55·4	8	12	4	·943	·502	·53	...	·0197	44·6	·0159	
2,720	13·1	54·5	11	15	4	·958	·487	·51	...	·02	43·5	·0159	
2,852	13·1	56·3	11	15	4	·989	·511	·52	...	·0197	45·3	·015	
3,010	13·1	58·3	11	15	4	1·02	·539	·53	...	·0193	47·4	·015	
...	12·9	9·6	...	...	...	...	...	...	·783	...	...	...	
930	15·2	28·4	12	18	6	·586	·250	·43	...	·0305	15·6	·0168	
710	14·8	24·4	12	18	6	·484	·191	·39	...	·0343	12·0	·0169	
620	14·7	22·6	12	18	6	·444	·167	·37	...	·0364	12·3	·0199	
1,120	15·6	32·2	12	18	6	·672	·3	·45	...	·0287	13·1	·0188	
1,280	16·0	35·4	12	18	6	·758	·344	·45	...	·0276	13·4	·0170	
1,480	16·0	38·9	12	18	6	·833	·398	·48	...	·0263	13·4	·0104	
1,660	16·2	43·5	12	18	6	·946	·489	·52	...	·0274	13·6	·018	
1,900	16·0	47·0	12	18	6	1·012	·51	·50	...	·025	13·5	·0176	
2,112	16·0	49·9	12	18	6	1·069	·567	·53	...	·0236	13·4	·0172	
2,488	16·3	55·7	12	18	6	1·217	·667	·55	...	·0223	13·7	·0168	
2,532	16·4	58·6	12	18	6	1·3	·68	·52	...	·0231	44·8	·0177	
...	20·6	17·1	...	...	...	...	...	...	·831	...	...	...	
...	16·7	14·5	...	...	...	...	...	...	·85	...	...	...	
510	18·4	23·8	15	23	8	·6	·183	·305	...	·0466	8·4	·0164	
700	18·5	27·5	15	23	8	·698	·251	·359	...	·0392	12·5	·013	
940	18·2	31·3	15	23	8	·77	·337	·43	...	·0322	16	·017	
1,120	18·9	34·8	15	23	8	·894	·402	·45	...	·0311	18·9	·0169	
1,300	18·9	38·3	15	23	8	·981	·466	·47	...	·0294	22·4	·0172	
1,400	19·8	42·1	15	23	8	1·129	·502	·45	...	·03	25·5	·0182	
...	24·4	19·7	...	...	...	...	...	...	·83	...	...	...	
1,600	20·1	46·1	15	23	8	1·257	·574	·46	...	·0288	29·2	·0182	
1,520	20·1	46·1	15	23	8	1·257	·545	·44	...	·0309	29·2	·0192	
1,700	19·7	45·8	15	23	8	1·22	·61	·5	...	·0269	29·4	·017	
1,670	19·7	47·3	15	23	8	1·26	·598	·47	...	·0283	30·8	·0184	
1,840	19·5	49·3	15	23	8	1·3	·66	·51	...	·0267	32·9	·0179	
...	22·2	18·3	...	...	...	...	...	...	·848	...	...	...	
1,820	19·3	49·3	15	23	8	1·29	·653	·50	...	·0276	33·1	·0181	
1,950	19·3	52·8	15	23	8	1·38	·7	·51	...	·027	36·6	·0187	
2,040	19·7	55·1	15	23	8	1·47	·73	·47	...	·0275	38·5	·0189	
2,200	19·8	56·8	17	25	8	1·53	·79	·52	...	·0257	40·2	·0182	
...	20·5	16·8	...	...	...	...	...	...	·834	...	...	...	
2,240	20·9	58·6	18	26	8	1·66	·8	·46	...	·0262	41·0	·0183	
2,540	20·5	62·3	18	26	8	1·73	·9	·53	...	·0245	45·3	·017	
...	20·5	16·5	...	...	...	...	...	...	·83	...	...	...	
2,200	19·8	58·0	18	26	8	1·55	·79	·51	...	·0263	41·4	·0188	
2,640	19·8	62·6	18	26	8	1·674	·95	·56	...	·0248	46·0	·0174	
2,600	19·8	63·2	18	26	8	1·69	·93	·55	...	·0243	46·6	·0179	
...	20·5	17·1	...	...	...	...	...	...	·83	...	...	...	
600	5·2	9·9	2	3	1	·07	·026	·37	...	·0166	5·5	·0092	
...	12·3	10·1	...	...	...	...	...	...	·872	...	...	...	
280	5·0	6·1	2	3	1	·045	·012	·274	...	·0216	1·9	·0068	
620	5·0	9·9	2	3	1	·069	·027	·39	...	·0159	5·7	·0092	
1,000	5·0	13·9	2	3	1	·097	·044	·45	...	·0139	9·7	·0097	
1,010	5·0	13·9	2	3	1	·097	·045	·46	...	·0137	9·7	·0096	
...	16·4	13·0	...	...	...	...	...	...	·831	...	...	...	
1,160	5·7	17·4	3	4	1	·138	·052	·39	...	·015	12·6	·0108	
1,240	5·7	17·4	3	4	1	·138	·056	·41	...	·0131	12·6	·0101	
1,650	5·4	20·9	3	4	1	·151	·074	·49	...	·0128	16·4	·0099	
1,440	6·1	20·9	3	4	1	·172	·064	·37	...	·0145	15·8	·0109	
1,640	5·4	20·6	3	4	1	·149	·073	·49	...	·0125	16·1	·0098	
...	23·9	20·3	...	...	...	...	...	...	·848	...	...	...	
1,800	5·7	25·5	3	4	1	·196	·08	·41	...	·0141	20·7	·0115	
1,900	5·6	24·6	3	4	1	·18	·087	·47	...	·0129	19·9	·0105	Indicator.
1,900	5·6	24·6	3	4	1	·18	·087	·47	...	·0129	19·9	·0105	Counter.
2,200	5·8	28·4	3	4	1	·228	·098	·44	...	·0129	23·5	·0107	
...	30·3	25·8	...	...	...	...	...	...	·851	...	...	...	
2,280	5·7	28·7	3	4	1	·220	·102	·46	...	·0125	23·9	·0105	
2,500	6·1	31·9	3	4	1	·263	·112	·43	...	·0127	26·7	·0106	
2,600	5·7	31·9	3	4	1	·245	·116	·47	...	·0122	27·1	·0104	
2,700	5·8	35·1	3	4	1	·274	·121	·44	...	·013	30·2	·0112	
2,720	5·9	35·4	3	4	1	·278	·122	·44	...	·013	30·4	·0112	
...	20·5	16·2	...	...	...	...	...	...	·821	...	...	...	
3,080	5·9	40·0	3	4	1	·318	·138	·44	...	·0129	35·0	·0114	
									Mean				
...	...	...	...	...	...	...	...	...	·841	...	...	...	
5,200	4·6	40·0	No load.			·246	...	...	...	·0076	36·1	·0069	

Horse-power taken out = speed × ($W_1 - W_2$) × ·0000448. The diameter of the pulley was 2½ inches, and the diameter of the pulley + the thickness of the belt was 2⅝ inches, giving a mean 2·5625 inches from which the above was calculated, W_1 and W_2 being in kilogrammes. The weight of the motor was 72 lbs.

(To be continued.)

A FRICTION CLUTCH AND COUPLING.

WE have already described several well known forms of friction clutches which are now being used in considerable numbers for starting and stopping wheels, pulleys, shafts, &c. That the employment of such apparatus as substitutes for driving belts, which, in machinery operations, have frequently to be shifted from fast to loose pulleys, is extending itself in England is evident, and the latest addition to these very useful adjuncts to the driving of machinery is that of Messrs. Mather & Platt, illustrated below. Fig. 1 represents the apparatus applied as a shaft coupling, and fig. 2 as a pulley driving and releasing clutch. The special advantages claimed for Messrs. Mather & Platt's clutch are, simplicity, durability, compactness, and cheapness. Attention is called to the facility with which it can be thrown in or out of gear, and that the machinery which it couples can be started without shock or jar or fear of a breakdown when running at full speed. That the advantages here set forth are absolutely necessary in electric lighting machinery we need scarcely enforce, nor that the successful working electric light plant depends almost entirely upon the perfection of the mechanical arrangements. Further information as to sizes and prices can readily be obtained from the makers, and we have no doubt but that these clutches will soon be in continuous demand.

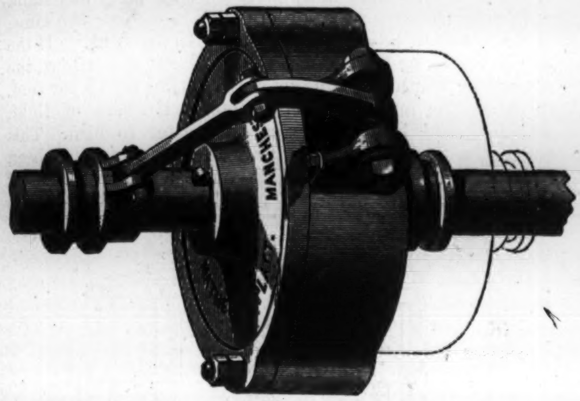

FIG. 1.

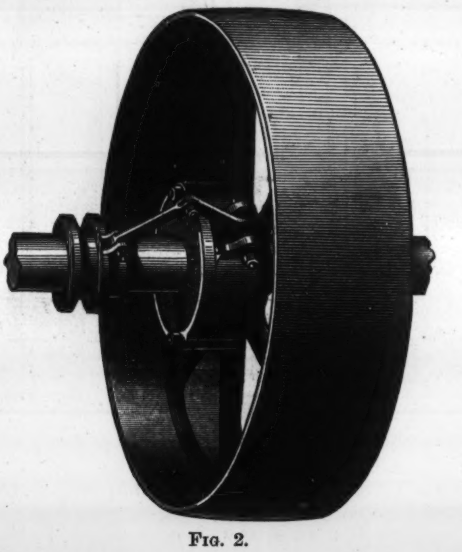

FIG. 2.

Block Telegraph System.—In the half-yearly report of the North British Railway Company, just issued, it is stated that during the period covered the company has expended the sum of £11,174 on the extension of the telegraph block system.

A NEW ELECTRICITY-METER.

THIS apparatus, brought before the *Académie des Sciences* of Paris, by M. Dumas, the permanent secretary, is now being subjected to an examination in detail by the physical section, in which M. du Moncel has been requested to take part.

The principle of the mechanism is, according to M. Cauderay in *L'Electricien*, realised in the following manner (fig. 1):—

R is a cylinder of any dimensions, moved by clockwork and turning on its axis, *i*, at the rate of one revolution per second, for example. This cylinder, something like the barrel of a musical box, is furnished with teeth, *d*, arranged in a certain manner, on circles traced, at equal distances from each other, on the surface of the cylinder. The circle, *m*, which divides the cylinder into two equal parts, does not contain any of the teeth. On each of the circles, *n*, to the right and left of the centre one, is one tooth; on the second circles, *o*, two teeth; on the third, *p*, three teeth, and so on to the extremities of the cylinder; *a* is the needle of an ampère-meter, constructed for the purpose, the point of which is opposite the circle which divides the cylinder into two equal parts, and at a very little distance from it. In this position, and when no current is passing through the apparatus, the cylinder, R, can turn without any of the teeth coming in contact with the needle, *a*; but if a current, of one ampère, for example, passes through the ampère-meter, the needle will deviate to the right or to the left, according to the nature of the current, and come opposite the circle, *n*; at each revolution of the cylinder, R, the tooth, *d*, on the circle, *n*, will lightly press the needle, *a*, and by means of an electrical or mechanical arrangement, easily imagined, will cause the hand of a dial, similar to those employed in gas meters, to advance one unit per second, it being already supposed that the cylinder, R, makes one complete revolution in a second.

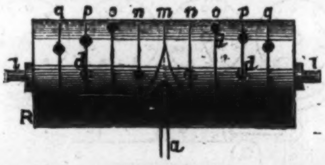

FIG. 1.

If the current passing through the apparatus is two ampères, the needle, *a*, will come opposite the circle, *o*, on which are two teeth, and at each revolution of the cylinder the hands of the dial will register two units, and so on with higher strengths of current. A clockwork movement marks the seconds and makes the cylinder revolve; a catch enables the clockwork to start as soon as the difference of potential is sufficient to produce the normal light, and stops it if it falls below the required power, or if it is extinguished.

It is not necessary to state that the apparatus will register not only ampères, but also half-ampères, and quantities more minute still. The same may be said of the objection that the needle might pass between the teeth without touching them. It stands to reason that the case has been foreseen, and that it is impossible. Besides, practical trials, made under most unfavourable conditions, either in the laboratories of the academy by scientific men, or in various workshops, have shown the perfect accuracy of the apparatus. A satisfactory answer has been given by means of experiments made with very powerful instruments, to the objection that the needle of the galvanometer might be made to deviate by means of a powerful magnet or electromagnet, and that the consumer might in this way defraud the company. The impossibility of all fraud has been clearly shown.

The principal advantages of this meter are the following:—

(1.) The entire mechanical apparatus, being based on the physical effects of the currents, is benefited b all their advantages, unlike the meters based on the chemical effects.

(2.) The resistance being invariable and very slight (about the thousandth part of an ohm) enables the entire current to be measured to pass through the coils of the apparatus, which constitutes a very great advantage, as far as accuracy of results is concerned.

(3.) The nature of the current can be changed frequently without affecting the accuracy of the indications.

(4.) The apparatus can work in all positions, without failing in accuracy.

(5.) The meter indicates the quantity directly in coulombs. Knowing that, for lighting by incandescence, calculation shows that a cubic meter of gas gives the same quantity of light as 10,080 coulombs,[*] the inventor has profited by the fact and graduated the dials of the apparatus in myria-coulombs, a quantity which will practically be comparable to the cubic metre of gas.

(6.) As the magnetic field of the ampère-meter can be regulated at will, it will always be very easy to gauge it afresh or to regulate it, if upon trial it should be found that, after some months or years, a change has taken place in the magnetic condition of the magnet.

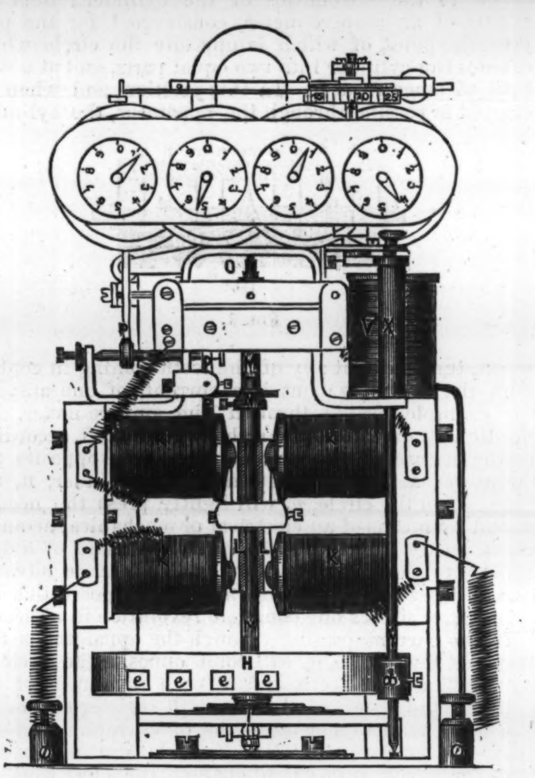

FIG. 2.

(7.) Finally, it will be very easy to substitute for the ampère-metre an electro-dynamometer, and thus to measure alternating currents.

Construction of the practical apparatus.

The intention is to construct three models of electricity meters in order to meet the requirements not only of electric lighting, but also those of other industries and of scientific researches.

The first type will be intended for scientific researches, and will not only be constructed with all the exactness required, but will besides be adapted to measure the lowest intensities, in very short spaces of time, kept in action by very feeble electromotive forces or by means of some clockwork arrangement.

The second type, for industrial use, will be constructed to measure any quantities whatever, whatever the difference of potentials may be.

The third type, intended specially for lighting by incandescence, measures any number of ampères whatever. It can be constructed at will for differences of potentials at the terminals of the apparatus, of 25, 50, or 100 volts, as required. Attention is called to the fact that this arrangement presents great advantages to consumers, for we know, to give only one instance, that the Edison lamp requires 100 volts to produce its normal light. Now, if the difference of potential should fall to 85 volts, for instance, through some cause or other, the lamp will give scarcely any light, although the intensity of current is almost the same, since it would be diminished only 15 per cent.[*] If the meter continued to work under these conditions, the consumer would only have a reduction of 15 per cent. in price, for an almost complete extinction of light, which would be a very serious matter to him. This contingency was foreseen, and the apparatus has been constructed and regulated in such a manner that if the difference of potential should fall to 85 volts, the clockwork would stop and the apparatus cease to register.

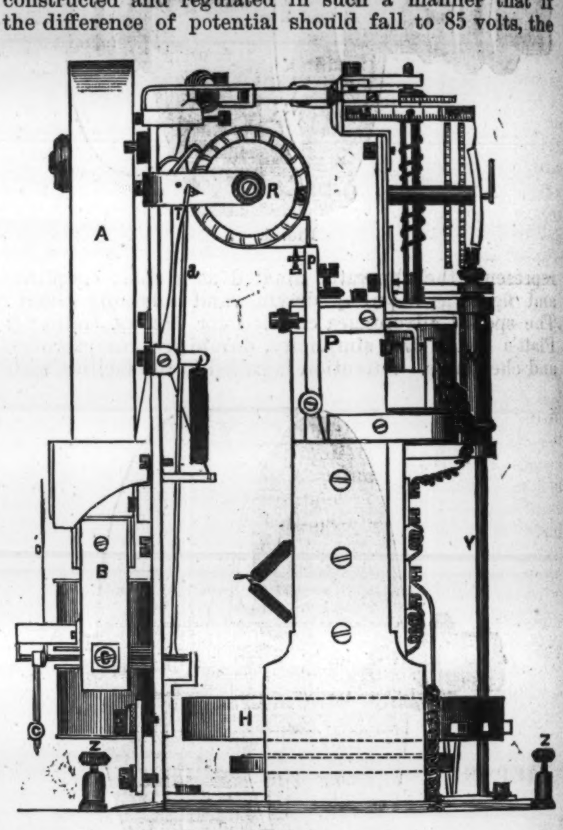

FIG. 3.

Therefore, if a company should supply light, sufficient in quantity, but of bad quality, the apparatus will not work until an improvement is effected and the normal quality produced.

The descriptions accompanying figs. 2 and 3 will enable our readers to form an idea of the construction of the apparatus, which is capable of certain modifications and simplifications according to the purposes for which it is intended.

Explanation of figures.

Fig. 2. Front view of the meter. Fig. 3. Side view.

Galvanometer.—A, Allevard steel magnet; *a*, large needle, bearing at its point a small triangular piece of bronze, against which the teeth of the cylinder, R, press; *b*, small indicating hand; *c*, counter-balance of the needle; B, poles of soft iron; C, movable poles of the galvanometer, enabling the magnetic field to be modified at will; D, coils of the galvanometer.

---

[*] With an electromotive force of 100 volts.

[*] This is true *only* if the resistance of lamp remains constant.—EDS. ELEC. REV.

Clockwork.—H, circular balance, weighing about 700 grammes, regulated by means of the spiral, I, at the rate of one double oscillation per second, and kept in motion by the electro-magnets, K, K, attracting the armatures, L, L, fixed on the axle, M, of the balance; I, steel spiral regulating the oscillations of the balance, H; K, K, fine wire electro-magnets, of about 1,000 ohms resistance, actuated by a derivation from the principal current, the passage of which is regulated by means of the well-known method employed by M. Hipp for his regulators, but modified so as to be suited to the circular system. This arrangement is not shown in the drawing. L, L, soft iron armatures, attracted by the electro-magnets, K, K, and actuating the balance, H; M, steel axle supporting the balance, H, the spiral, I, the armatures, L, L, the eccentric button, N, and the regulator of the current acting on the contact spring, O; N, eccentric button adjusted to transmit a movement of one revolution per 100 seconds to the cylinder, R, by means of the levers, P; O, contact spring worked by a little regulator, on the Hipp system (not shown in the drawing), and making the current pass into the electro-magnets, K, K; P, levers of transmission between the balance, H, and the cylinder, R; R, principal part of the apparatus, consisting of a cylinder moved by the balance, H, at the rate of one revolution in 100 seconds, and bearing on the surface, teeth, arranged as we have already described in our explanation of the principle on which the apparatus is based; S, ratchet wheel of 100 teeth, fixed on the axle of the cylinder, R, and serving to transform the backward and forward movement of the transmitting lever, P, into the rotary movement of the cylinder, R; T, T, lever of transmission between the galvanometer needle and the registering apparatus; U, U, U, U, dials of the registering apparatus. The dial to the right indicates the units in myria-coulombs; the others the tens, hundreds, and so on; V, electro-magnet of thick or fine wire, according to the requirements of the mechanism by means of which the clockwork apparatus is put in motion as soon as the instrument is traversed by a current capable of being registered by it; X, body bearing the cam of this mechanism; *d*, cam bringing the balance to rest with the help of the teeth, *e*, *e*, *e*, *e*, fixed on the balance, H, when the current is interrupted; *e*, *e*, *e*, *e*, ratchet teeth fixed on the circumference of the balance, H; Y, axle of transmission of the armature, X, to the cam, *d*; Z, terminals for the conducting wires.

REPORT ON THE EDISON-HOPKINSON DYNAMO.

I HAVE to make the following partial report of the tests of the new dynamo-electric machine built by Mather and Platt, of Manchester.

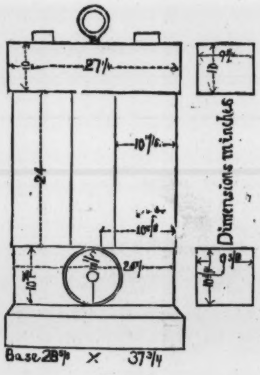

FIG. 1.

Fig. 1 shows the general shape and dimensions of machine.

Additional dimensions and characteristic features of the dynamo are:—

General arrangements, those of a shortened and differently proportioned Edison dynamo.

Pulley, however, is outside of bearing, and with a face of 6⅜″, and diameter of $10\frac{1}{16}''$ projects 8¼″ outside the base plate.

Field coils wound over a 9″ core with ten layers of No. 16 copper wire (B.W.G.). Two legs in series.

Armature. Diameter of core 9″, 74 coils, single turn, eight strands of No. 16 wire, average length 43″.

Wire bound. Diameter 10½″ with $\frac{1}{16}''$ clearance from pole faces.

Zinc plate connecting pole faces.

Ends of magnets *not* scraped.

Resistances. Field cold 36·5 ohms.

Armature cold ·026 ohms.

Field measured, armature calculated.

Field warm 37 ohms.

Armature warm ·0325 ohms.

Power supplied from a Lawrence (Armington and Sims) engine, high speed and non-condensing, driving by a link belt through an Alteneck tension belt dynanometer.

Engine diam.	8½″	accepted.
„ Stroke	$9\frac{15}{16}''$	measured.
„ Piston Rod ...	1⅜″	„
„ Fly Wheel ...	40″	„
Indicator Spring	56″	„

$$1\text{ H.P.} = \frac{2\text{ P. L. A. rev.}}{33{,}000}$$

$$= \frac{\frac{2\text{ P. }9\frac{15}{16}}{12}\cdot\frac{\pi}{2}\left(2\cdot 4\tfrac{1}{4}^{2} - 1\tfrac{1}{16}^{2}\right)\text{. rev.}}{33{,}000}$$

$$= \text{Mean pressure} \times \text{rev.} \times \cdot 0028107.$$

The mean pressure is best found by taking area of cord with a planimeter dividing by the length of cord, and multiplying by the spring.

Engine not permanently secured, but firm enough to drive well.

Revolutions timed by reference to a continuous counted running motion from valve stem.

Boiler pressure from 97 to 104 lb.

Dynamometer. Alteneck pattern. Designed to measure difference of tension of two parts of belt.

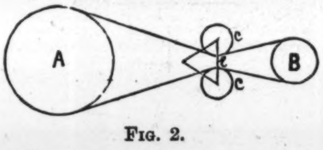

FIG. 2.

A. Driving Pulley.

B. Driven pulley.

C C. Pulleys with faces close together, and gripping the two parts of the belt. The lower is the driving part, and the resultant pull is downwards, which pull is opposed by an upward external and measurable pull which keeps the dynamometer in a central position.

The following were the dimensions:—

Diameter A	40″
„ B	$10\frac{1}{16}''$
„ C	$9\frac{5}{16}''$
Dist. apart of centres of C C, ...	11½″
Thickness of belt	$\frac{9}{16}''$
Resistance A E	117″
Resistance B E	26¼″

To find constant, we have the following:—

τ Tension on lower belt.
τ^1 „ „ upper „
2 r & p Diams. of small pulleys B and C.
2 R „ „ large pulley A.
κ Thickness of belt.
α & β Half enclosed angles on each side.
d Distance from E to centre of B.
D „ „ „ A.
l „ apart of centres of C C.

Then net spring = difference of pulls.

$$=(\tau-\tau^1)(\sin^{\circ}\alpha+\sin^{\circ}\beta)$$

$$\sin^{\circ}\alpha=\frac{r-\frac{1}{2}(l-p-2\kappa)}{d}=\frac{r-\frac{l}{2}+\frac{p}{2}+\kappa}{d}$$

$$\sin^{\circ}\beta=\frac{\mathrm{R}-\frac{l}{2}+\frac{p}{2}+\kappa}{\mathrm{D}}$$

$r=5\frac{1}{32}''$ $\qquad d=26\frac{1}{4}''$
$l=11\frac{1}{2}''$ $\qquad \mathrm{D}=117''$
$p=9\frac{5}{16}''$ $\qquad \mathrm{R}=20''$
$\kappa=\frac{9}{16}''$

Then $\sin^{\circ}\alpha=\cdot17143$
$\sin^{\circ}\beta=\cdot16640$
$\sin^{\circ}\alpha+\sin^{\circ}\beta=\cdot33783$

$$\tau-\tau^1=\frac{\text{Spring}}{\cdot33783}=2\cdot96\text{ Spring.}$$

$$\text{H. P.}=\frac{\text{Speed}\times(\tau-\tau^1)}{33000}$$

$$=\frac{\text{Rev. of B.}\times\pi\times\frac{10\frac{1}{16}}{12}\times\frac{\text{Spring.}}{\cdot33783}}{33000}$$

$$=\cdot0002363\times\text{rev.}\times\text{spring.}$$

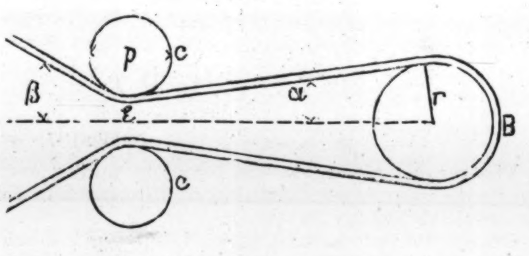

Fig. 3.

That is, the H. P. transmitted is the product of the increased tension on supporting spring, the revolution of the dynamo, and the constant factor ·0002363.

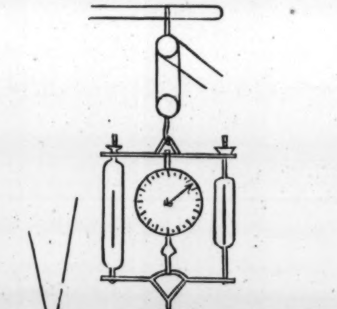

Fig. 4.

To prevent violent vibration, and to facilitate readings, there were used three springs and a dash pot. The ranges of springs were 60,100, and 180 lbs, two being direct and one circular. These were supported by bridle arms, and were raised or lowered by tackle.

The connection between lower bridle and dynamometer frame was by a rubber band. The dash pot was a cylinder full of oil, in which moved an iron pulley, wrapped with manilla rope.

The play of the dynamometer did not exceed $\frac{1}{32}''$.

It was first balanced at rest, then free, and finally with load.

Instruments for measuring potential and current were of the "Thomson" design, the current in the lamp circuit and the potential at the brushes being taken.

The magnets were tested by the Poggendorff method, as in fig. 5.

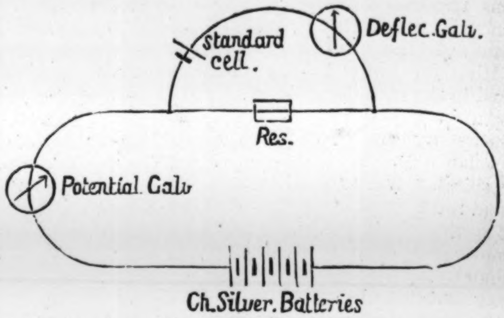

Fig. 5.

$$\text{Total H. magnetic field}=\text{Gr.}\times\frac{\text{Position.}}{\text{E}\times\text{Resist.}\times\text{Dif.}}$$

E = 1·457 Clarke's standard.
Gr. = 6428

Mean force in laboratory—Westminster—

	Earth	No. 45	No. 17
May 7.	·121	9·41	11·40
„ 8.	·122	9·46	11·45
„ 12.	·122	9·40	11·52

Total H. Field for Manchester—

E and 45	9·55
E and 17	11·61

Characteristic curve, fig. 6—

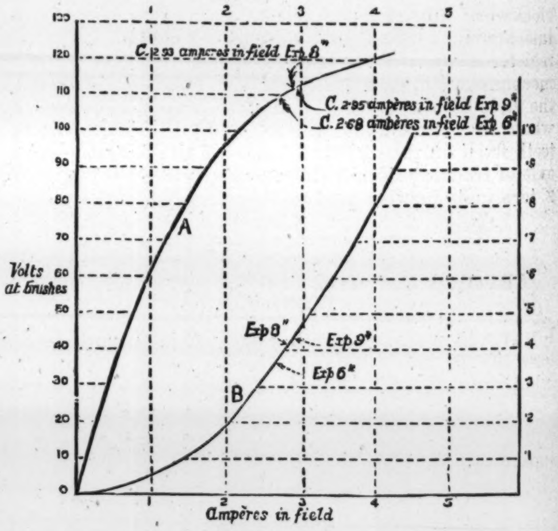

Fig. 6.

This was found by taking the potential at the brushes, the field magnets being excited by a separate machine. The only current passing through the armature was that in the high resistance galvanometer and leakage, a ground of unknown resistance. This curve is designated A.

Another curve, B, is added. This gives the electrical energy expressed in H.P. expended in the field of 37 ohms.

In A vertical distance, or ordinates, are volts and abscissæ current in ampères.

In B ordinates represent H.P., while abscissæ are the same as in A.

The results of three fairly full loads are given.

No. 6.

Time, about 1 hour.

Load, 192 lamps, and ground of about 5 ampères. Lamps not up to candle-power.

Potential galvanometer :	
Magnet	No. 45
Position	2
Strength	9·55
Average deflection	20·79
Potential at brushes	99·27 volts.
Current galvanometer :	
Magnets	No. 17
Position	2
Strength	11·61
Average deflection	19·39
Current in lamp circuit	112·56 ampères.
„ field	2·68 „
„ armature	115·24 „
Resistance lamp circuit	·882 ohms.
and field	·861 „
Total resistance of circuit	·8935 „
E. M. F.	102·97 volts.
Electrical energy in lamp circuit	14·97 H.P.
„ „ field	·36 „
„ „ armature	·58 „
Total	15·91 H.P.
Dynanometer spring :	
At rest	112·23 lbs.
Running free	115·00 „
Load	180·11 „
Total difference	67·88 „
Above friction	65·11 „
Total power to armature	17·34
Power above friction	16·63
Friction	·71
Dynamo speed	1081
Engine „	289·3
Efficiency of conversion	95·7 per cent.
Commercial efficiency	86·3 „

Dynamo behaved well. Fields cold. Armature moderately warm. Wrist not uncomfortable on coils. Can also be held on commutator. Little sparking. Some lateral play of armature and spindle. Bearings cool. No increased heating after standing.

No. 8.

Time, 31 minutes.

Load, 192 lamps, and ground of about 5 ampères = say, 199 lamps.

Potential galvanometer—Magnet	No. 45
Position	2
Strength	9·55
Average deflection	22·62
Potential at brushes	108·01 volts
Current galvanometer :	
Magnet	No. 17
Position	2
Strength	11·61
Average deflection	21·2
Current in lamp circuit	123·07 ampères
„ field	2·92 „
„ armature	125·99 „
Resistance lamp circuit	·877 ohms
and field	·857 „
Total resistance of circuit	·8895 „
E. M. F.	112·09 volts
Electrical energy in lamp circuit	17·81 H.P.
„ field	·42
„ armature	·69
Total	18·92 H.P.
Dynanometer spring :	
At rest	112·23 lbs.
Running free	115·00 „
Load	188·61 „
Total difference	76·38 „
Above friction	73·61 „
Total power to armature	20·88 H.P.
Power above friction	20·12 „
Friction	·76 H.P.
Dynamo speed	1157
Engine	309
Efficiency of conversion	94·0 per cent.
Commercial efficiency	85·3 „

9·5 lamps per total H.P.
9·9 „ „ absorbed H.P.
10·6 „ „ H.P. electrical energy
11·2 „ „ H.P. of „ in ex. cir.

REMARKS.—Lamps not being close to machine, they were probably not quite up to candle power, although all in the room seemed well up.

Similar remarks about behaviour of dynamo as were made in experiment 6. There was no apparent increase in heating.

No. 9.

Time, 1 hour and 1 minute.

Load, 230 lamps, and ground of about 5 ampères=say —237 lamps.

Potential galvanometer :	
Magnet	No. 45
Position	2
Strength	9·55
Average deflection	22·89
Potential at Brushes	109·3 volts.
Current galvanometer :	
Magnet	No. 17
Position	2
Strength	11·61
Average deflection	24·91
Current in lamp circuit	144·60 ampères.
„ „ field	2·95 „
„ „ armature	147·55 „
Resistance lamp circuit	·756 ohms.
„ „ and field	·741 „
Total resistance of circuits	·7735 „
E. M. F.	114·13 volts.
Electrical energy in lamp circuit	21·18 H.P.
„ „ „ field	·43 „
„ „ „ armature	·95 „
Total	22·56 H.P.
Dynamometer spring :	
At rest	112·23 lbs.
Running free	115·00 „
Load	200·4 „
Total difference	88·17 lbs.
Above friction	85·40 „
Total power to armature	24·56 H.P.
Power above friction	23·79 „
Friction	·77 H.P.
Dynamo speed	1179
Engine „	315½
Efficiency of conversion	94·8 per cent.
Commercial efficiency	86·2 „

9·6 lamps per total H.P.
9·9 „ „ absorbed H.P.
10·5 „ „ H.P. total electric energy.
11·2 „ „ H.P. electric energy in ex. cir.

Same remarks about lamps, and about behaviour of dynamo as were made in experiments 6 and 8, are pertinent to this experiment.

There was no appreciable increase in the heating, and the load could have easily been carried a long while. An increased load of 30 lamps could be carried some time.

BRIEF OF THREE EXPERIMENTS.

		Speed.		Current in Amperes.			E. M. F. in Volts.		Electric H.P. appearing.				H.P. Delivered to Pulley.		Efficiency.	
No.	Time.	Engine.	Dynamo.	Field.	Lamp Circuit.	Total.	Brushes.	Total.	Field.	Armature.	Lamp Circuit.	Total.	Absorbed.	Total.	Conversion.	Commercial.
6	1 hour	289	1081	2·68	112·56	115·24	99·3	103·0	·36	·58	14·97	15·91	16·63	17·34	95·7	86
8	31 mins.	309	1157	2·92	123·07	125·99	108·	112·1	·42	·69	17·81	18·92	20·12	20·88	94·0	85
9	1 hr. 1 min.	315½	1179	2·95	144·6	147·55	109·3	114·1	·43	·95	21·18	22·56	23·79	24·56	94·8	86

Means: 94·8 °/₀ 86 °/₀

(Signed) **FRANK J. SPRAGUE,**
May 17*th*, 1883, London.

To E. H. Johnson, Esq.

THE VIENNA ELECTRICAL EXHIBITION.

(*Continued from p.* 174.)

THE use of electric bells for domestic purposes dates, we believe, as far back as 1850, in which year the Berne Chamber of Deputies was fitted with these appliances by Messrs. Hipp, of Neufchatel, Switzerland. At the present time the old pull system, with its cranks and somewhat clumsy bells, although it by no means deserves the stigmas which fitters of the electric system cast upon it in their prospectuses, is somewhat out of date, and is at times hard pushed by its more convenient rival. The general arrangement of the domestic electric bell system has undergone practically but very little alteration within the last 20 years; indeed there has been but little to alter. Accordingly we find in exhibits of this description but little scope for the manufacturer, except as regards general finish, and this at the Vienna Exhibition is all that can be desired.

The use of phosphor and silicium bronze wire for special purposes, where great tensile strength and lightness are required, is likely to be considerable, and it would probably be still greater were the material of a less springy nature than is actually the case; this nature, as in steel, renders the wire difficult for linemen to handle. Unlike steel, bronze does not waste away by rusting, and consequently its durability is very considerable. Several long spans of this wire, of small diameter, and especially suitable for telephonic purposes, are shown stretched in the exhibition building.

A few displays (of an interesting character) of educational apparatus are to be seen; in most cases these are for showing elementary principles, and are well suited for the purpose, being of cheap construction. As a rule scientific educational apparatus for showing the practical application of principles is not designed as satisfactorily as it might be, the actual form and arrangement of the parts being quite unlike those which are seen in practice. This is much to be regretted, as the student, when he comes to make a practical application of his knowledge, finds that he has obtained very mistaken notions with reference to the apparatus which is actually used. The practice of teaching by means of illustrations of instruments which are unlike those actually employed is very inexcusable in the case of text books, as it is quite as easy to sketch from an actual instrument as to draw the absurdly ill-proportioned pieces of apparatus which are so continually met with. If a drawing is intended to be purely diagramatic, a considerable degree of license is allowable, and it is not misleading.

Amongst the telegraphic apparatus at the exhibition we have the usual specimens of the Morse printer, exhibited by almost every manufacturer of telegraphic instruments, and in very few cases do we find two manufacturers exhibiting similar patterns, each preferring to put his own ideas into the specimens of workmanship shown. The Siemens' form of inker, which, in our opinion, is very far superior to any other pattern, does not appear to be so great a favourite as that of Digney. The use of unpolarised relays is still very general, although even for single current circuits (which are general, if not universal, on the continent), the polarised patterns are greatly superior as regards sensitiveness and other qualities which are of importance in a relay.

It is a noticeable fact that the arrangement of the relay contacts is almost invariably wrong. It is usual to have a small flat platinum plate on the tongue, and a blunt point on the contact screw. Such a combination must eventually cause sticking, as in course of time a hole becomes worn in the plate, and then the working commences to be irregular. In one relay exhibited the contact plate on the tongue is not fixed on the latter, but is arranged so that it can be slid along it, thus enabling a fresh surface to be brought opposite the contact point when necessary. In all the relays employed in the British Postal Telegraph Department the platinum contact on the tongue is not formed of a plate, but of a piece of platinum wire, $\frac{1}{16}$ of an inch in diameter and about $\frac{1}{4}$ of an inch long, fixed at the end of the tongue, and at right angles to it. The contact on the contact screw or screws is formed of similar platinum wire, so that the surfaces in contact are of exactly the same area. This entirely prevents sticking, even when high battery power is in connection with the contacts. It is somewhat curious that this arrangement, which is obviously a correct one, should not have been more generally adopted.

The French Administration show in action the Caselli and also the D'Arlincourt copying telegraphs; the latter we gave a description of in the number of the REVIEW for Jan. 15th, 1879. The Caselli instrument is similar in general principle to that of D'Arlincourt, but differs from it in the method by which the synchronous movements of the styles over the surfaces of the papers is effected. Neither instrument is, we believe, now in practical use, nor do they seem likely ever to be practically adopted. They do not supply a want, as the latter does not exist. The Baudot apparatus, of which we have given full descriptions in recent numbers of the REVIEW, is also shown in full operation.

The use of the duplex principle, so common in America and England, does not seem to be very general on the Continent, that is to say, its employment is more exceptional than otherwise. The only display of "quadruplex" apparatus is that made by the British Postal Telegraph Administration. Since the first introduction of this system from America the whole of the instruments have been entirely remodelled, and with the most satisfactory results. The new form of compound relay is especially worthy of notice. It is, we believe, the intention of the department to considerably increase the number of sets of quadruplex apparatus in use, in view of the increase of traffic which must result from the introduction of sixpenny telegrams.

(*To be continued.*)

THE LATE MR. C. F. VARLEY.

CROMWELL VARLEY was born in the parish of Westminster, on April 6th, 1828, and was the second son of the late Mr. Cornelius Varley,* an artist by profession, but better known for his microscopical researches, and as an active member of the Society of Arts, of which, at the time of his death, he was the oldest member.

Mr. Cornelius Varley was an enthusiast who never permitted anything to keep him away from his chapel on Sundays or from a scientific gathering during the week, and he took his elder sons with him wherever he could.

Faraday was the most prominent Elder of the little sect to which Mr. Cornelius Varley belonged, and his family were brought up to regard him in the twofold light of religious teacher and scientific exemplar.

Mr. Cornelius Varley's house was a sort of museum of scientific odds and ends. Electrical and scientific apparatus were the only toys, and a workshop and laboratory were the playground in which his sons passed most of their spare time.

From a schoolmaster's point of view, Cromwell Varley was far from being a model boy, lessons being as irksome to him as constructing galvanic batteries and experimenting were a delight. When electrotyping engaged public attention Mr. Varley became an enthusiastic electrotyper, and, whilst still a youth, he constructed an earth battery, making use of the water-pipes for one element and several bushels of coke buried in the earth for the other. With this battery, the action of which was very slow, he took more than one electrotype. He was a neat manipulator and most painstaking and persevering in any work he undertook on his own account. His favourite text-book was Noad's "Lectures on Electricity;" the lectures he most delighted to attend were those delivered by Grove at the Royal Institution. Batteries have somewhere been described as "copper and zinc, acid and stink," but they were not so to Cromwell Varley. Amalgamating the zincs, charging the batteries, emptying them afterwards, and washing the plates, which are so irksome to most people, were no trouble to him. It may therefore be fairly claimed for Mr. Varley that he was an electrician by natural selection and not, like many of our telegraph engineers, by force of circumstances.

In 1846 he entered the service of the Electric Telegraph Company, and two years later he was appointed assistant to the superintendent of the street work. The underground wires of those days were cotton-covered copper wires insulated by a mixture of resin and Stockholm tar inclosed in leaden tubes, and were a source of great trouble from their continually getting out of order. Mr. Varley here found himself in his own special element, locating with comparative facility the position of intermittent faults (which so baffled his colleagues), and cutting out the bad portions and repairing the wires. He experimented with these wires, recognised they possessed conditions favourable for the manifestation of induction, observed indications of it and made use of this indication as a test of the insulation.

The introduction of gutta-percha covered wires in 1849 greatly improved the insulation of the underground lines, and Mr. Varley made use of the capability of the insulated wire to retain a statical charge, as a more searching test of the perfection of the insulation than that of the deflection of a galvanometer. In the latter end of 1851 Mr. Varley had the opportunity of experimenting upon a length of ten miles of gutta-percha covered wire. Among other experiments, this wire was charged statically by 300 battery cells, and discharged like an ordinary Leyden jar through the human body, a very powerful and unpleasant shock being experienced. The conclusion at which Mr. Varley then arrived was, that if gutta-percha covered wires were employed for circuits of considerable length, induction would manifest itself so powerfully as to offer serious obstacles to telegraphing. These views were represented at headquarters, but they were disregarded. A few years later underground circuits were established between London, Birmingham, Manchester and Liverpool, when induction manifested itself to as great or a greater degree than had been anticipated by Mr. Varley. This manifestation was regarded by his colleagues as a new phenomenon, which could not have been anticipated. Faraday was consulted to help them out of their difficulties, and he made it the subject of an instructive lecture, in which he referred to this phenomenon as a "strong confirmation of the truthfulness of the views he had put forth as far back as 1838." Mr. Varley's time had now come. He was appointed telegraphic engineer of the London district, but from that time he became practically the electrical adviser to the Electric and International Telegraph Company. On February 16th, 1854, Mr. Varley took out his first patent for what is known as Varley's double current system, which practically overcame the difficulty of working through underground circuits of such lengths as then existed. This patent was rapidly followed by other patents for translating apparatus and other purposes too numerous to mention.

In 1857 the Atlantic Telegraph Company was projected, and submarine telegraphy engaged the attention of the Institution of Civil Engineers, and was the subject of more than one paper read before them. Mr. Varley's brother, Mr. Alfred Varley, submitted papers to the Institution of Civil Engineers and Society of Arts, on the "Electrical Qualifications Necessary in Long Submarine Cables," and also on the "Practical Bearing of the Theory of Electricity in Submarine Telegraphy." In these papers he demonstrated that the electrical conclusions on which the construction of the cable was based were erroneous, and that the plan advocated by Dr. Siemens, of forming the conductor of the cable of two wires separated a short distance from one another, and coated with gutta-percha, using one of them in place of the earth for the return circuit, would greatly increase the retardation instead of halving it, as Dr. Charles Siemens then anticipated. These papers were reproduced in the scientific journals of the day, and after the breaking down of the first Atlantic cable Mr. Cromwell Varley was consulted, and he became electrical adviser to the Atlantic Telegraph Company, and he was also appointed engineer-in-chief to the Electric and International Telegraph Company. Whilst holding these offices he brought out the double V insulator, which may be said to be almost universally adopted in this country. He greatly extended the telegraph system, and improved the general insulation of the lines. He also devoted his attention, and contributed largely, to solving the problem of working rapidly through long submarine cables, working for a time in conjunction with Sir William Thomson and Fleming Jenkin. He accompanied the 1865 expedition, which was not successful, and when in 1866 communication was successfully established between England and America, the cable was worked under the joint patents of Thomson, Varley, and Jenkin.

Mr. Varley possessed in a large degree that power of taking infinite pains which Carlyle has described as the attribute of genius. But in the true sense of the word he was not so original as to the outer world he appeared. In the inventions he brought forward there was often a germ, or something more than a germ, originating with somebody else. This was the case in his first patent, and also in some of his others. The electric multiplier, for example, which is described in the memoirs which have lately appeared in some of our contemporaries as arising from an inspiration of genius on the part of Mr. Varley, aided by two insulated saucepans, and which is stated to have been the foundation of Holtz's machine, was really based on "Peclet's Double Electrical Condenser," described in Noad's "Lectures on Electricity," published in 1849, the only difference being that the successive manual operations which Peclet employed are ingeniously arranged in Mr. Varley's invention to be performed by turning a handle. The artificial line also, which was generally attributed to Mr. Cromwell Varley, was really the invention of his brother, Mr. Alfred Varley, who suggested its use for solving by direct experiment the rate of transmission through circuits having conductors of varying length and sectional area, and different thicknesses of insulating material; and it is minutely described in the paper, before referred to, which was read before the Society of Arts on March 30, 1859. If, however, it has to be confessed that Mr. Varley received a greater amount of assistance than he was willing to admit, it must be acknowledged that his clear perception grasped the whole of the subject whenever a good idea was suggested, and that he worked most unremittingly for its fulfilment; and if his assertive activity identified his name with the invention, his almost volcanic energy bore down opposition, and to him was often really due the credit of its practical realisation. On one occasion, at a public discussion, a claim was made by a telegraphic engineer to be the originator of the use of resistance coils for testing circuits, when the answer made by one of Mr. Varley's colleagues was, "Where are the coils? Where is the evidence of their adoption? Mr. Varley had not only suggested but he had made the coils, and shown us how to use them."

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* It has been erroneously stated that Mr. Varley's mother was a Miss Fleetwood, this is, however, incorrect, his father's mother was a Miss Fleetwood, a lineal descendant of General Fleetwood, who married Oliver Cromwell's daughter Bridget.

In this brief memoir much that Mr. Varley accomplished is necessarily omitted. His life, if fully written, is almost a history of the application of electricity to the purposes of telegraphy, beginning with the time when it was shown to be practicable to transmit human thought over a limited distance, and ending at a period when messages are being daily sent under the sea from continent to continent, to a distance only confined by the limits of our terrestrial system.

As the commencement of his public life was coincident with the beginning of a great scientific advance, so also is his death coincident with the beginning of another epoch in human progress. The consequences immediately flowing from the discovery (just seventeen years ago) of what Sir William Thomson has termed the fundamental principle of the dynamo, and which was made in the first instance by Mr. Varley's brother, Mr. S. Alfred Varley, demonstrate that, at no distant period, electric force will be used, not only for the conveyance of human thought, and the production of light as now, but also for the carriage of goods and human beings, as well as for other industrial uses.

Sir Wm. Thomson writes to us respecting Mr. Varley as follows:—

"I well remember when I first made his acquaintance at Valentia in the autumn of 1858, when he was sent by my brother directors to co-operate with me in examining into the cause of the failure of the cable after its short-lived success. I had been extemporising resistance coils to measure the insulation resistance of the cable. He came with a box of resistance coils ready made—a thing not then generally known—quite unknown, I might almost say, among English practical electricians. His application of condensers to facilitate the working of submarine cables—an invention which he made a few years later—proved most valuable in connection with the introduction of my syphon recorder on the Eastern Telegraph Company's lines, and soon came to be universally recognised as one of the most important of all the contributions of science to practical telegraphy. He was the first, I believe, to make condensers of the large capacity required for signalling through submarine cables. His 'artificial line,' a working model, as it were, of a great submarine cable, which his great condensers allowed him to realise—is the foundation of the method of duplexing submarine cables, which has been brought into successful practical use by Muirhead and Stearns, and which is undoubtedly by far the greatest improvement in the practice of submarine telegraphy that has been made since the completion of the instrumental methods for signalling now in use. I look back with great pleasure and satisfaction to all my intercourse with Cromwell Varley, as a friend, during the eight years of work ashore and afloat for realising Transatlantic telegraphy in which both of us had the privilege of taking a part."

Mr. J. Brailsford Bright, of 31, Golden Square, W., writing to the *Times* of Tuesday, says:—

"My attention has been drawn to the obituary notice in the *Times* of the late Mr. Cromwell Varley. While bestowing all honour due to the illustrious dead it is just to avoid even indirectly denying any of that which belongs to the living; and it is for this reason that I beg your leave to correct the account given by your writer of Mr. Varley's connexion with the Atlantic telegraph, an account which would mislead all but the best informed of your readers. The laying of the first Atlantic cable was successfully completed on the 5th of August, 1858. The engineer in charge was my father, Sir Charles (then Mr.) Bright, who received the honour of knighthood chiefly for this, one of the most arduous engineering tasks of modern times. He was assisted by Mr. Canning (since Sir Samuel), Mr. Henry Clifford, Mr. Woodhouse, and Mr. Everett. The chief electrician was Mr. Whitehouse, and the manager the well-known American, Mr. Cyrus Field. This cable subsequently failed through defects in the manufacture—a matter over which those in charge had no control. In the *Illustrated London News* of the 4th September, 1858, and other contemporary journals, full descriptions of this earliest Atlantic cable may be found. As telegraphic engineering developed itself, particularly in the departments of paying-out machines and of insulation, the difficulties of laying and maintaining subsequent cables have greatly diminished. In these improvements the late Mr. Cromwell Varley took a considerable share, I believe. The notices of him which have as yet been published certainly err by no means on the side of too great completeness or too great praise of his varied and indefatigable researches and of the useful part which he has played in electrical science."

NOTES.

Erratum.—In the letter which appeared in our correspondence columns last week with the initials T. J. H., the last line should read "although B's *application* was anterior to A's."

Electric Lighting.—In reference to the article we published last week respecting the electric light on the troopship *Malabar*, we may add that the whole system was officially tried for six hours on the 10th ult., with the following very satisfactory results:—

No. 1 machine was connected with lamps	64 A 137 B
Speed of machine ...	527 revolutions.
Current in ampères	111·3
E.M.F. in volts	97·1
Candle-power of A lamps	16
„ „ B „	10·7
No. 2 machine was connected with lamps	51 A 128 B
Speed of machine ...	500 revolutions.
Current in ampères	92·68
E.M.F. in volts	97·1
Candle-power of A lamps	16
„ „ B „	10·7

The light obtained in each lamp being kept uniform throughout the trial, no signs of flickering or unsteadiness being observed in any of them. On the following day the whole of the lights, with the exception of those of the yard-arm, were connected to No. 1 machine, and the following results obtained:—

Speed of machine, 527 revolutions per min.

No. of lamps in circuit	115 A 265 B
Current in ampères	160·5
E.M.F. in volts	79·68
Candle-power of A lamps	6·2
„ „ B „	4·0

It would not, however, be advisable to supply all of the lights from one machine. as the great current generated causes the armature to become heated.

The Forth Bridge at Alloa, which was commenced some 18 months ago is rapidly approaching completion. By the aid of four Brush lamps the work is carried on by night as well as by day.

A proposal has been made to light the Edinburgh Waverley Market by electricity while used for concerts, the necessary supply to be obtained from the North British Railway Company's system.

The residence of W. H. Holmes, Esq., Wellburn, Jesmond, has been lighted by Messrs. J. H. Holmes and Co., electrical engineers, Newcastle, with 40 incandescent lights. The lights are made by the Swan Company. The power is supplied by one of Crossley's ½-horse gas engines, driving one of Siemens' S D 5 dynamo machines, supplemented by 22 Faure-Sellon-Volckmar secondary batteries.

Messrs. George Prescott & Company having proposed to introduce the electric light at Rathfarnham, a committee of gentlemen has been appointed by the inhabitants to finally arrange terms.

The Library Association of the United Kingdom held its annual *soirée* at the Liverpool Free Library on Tuesday last. The large book rooms were brilliantly lighted with Swan incandescent lamps and storage batteries, under the supervision of Messrs. Holmes & Vaudrey. The Picton reading room was illuminated by Serrin arc lamps.

The Leeds Corporation has, it is reported, definitely abandoned the project for laying down an installation of electric lighting in and about the Victoria Hall, Town Hall, and new Municipal Offices. A full revelation of the whole circumstances of this extraordinary affair, and also the identity of the obstructionists, should be made; but that cannot now take place, says the *Leeds Express*, until the next Council meeting, early in October. When it does—if at all—it is imagined it will be found that those who from narrowness of mind and perverse views as to "public benefit" fought against the introduction of Free Libraries, the erection of a new cattle market, and other necessary reforms and improvements, are to blame for this discreditable muddle. From another source we learn that the Corporation has no intention of abandoning the scheme.

An Electrical Car in Paris.—The electrical tramcar trial was successfully accomplished on the 6th inst., by the French Electrical Power Storage Company. A distance of thirty English miles was made in about three hours. The locomotion is effected, as we mentioned last week, by means of Faure accumulators, weighing some fifty hundredweight, which are fixed under the tramcar seats, and connected with a Siemens machine placed under the floor. The estimated cost is one-half that of horse trams. The company who made the trip consisted of engineers and journalists. M. Ferdinand de Lesseps was among them. The *Pall Mall Gazette* says:—"Readers are once more treated to the story of the great success attained by the Electrical Storage Company in Paris, in driving omnibuses by means of the Faure accumulator. The estimated cost, we are told, is one-half that of horse trams. The weight of the accumulators used was 2½ tons. While there is no doubt that trams can be driven by electricity, it is almost equally indisputable that the cost of this method of traction would at present be at least double that of horse power."

Defrauding the South-Eastern Brush Electric Light Company.—Neville Hutchinson, thirty years of age, who had pleaded guilty to a charge of forging cheques, and defrauding his employers, the South-Eastern Brush Electric Light Company, was sentenced to five years' penal servitude by Mr. Commissioner Kerr, at the Central Criminal Court, on Tuesday.

Trial of an Electric Launch.—On Monday, Messrs. Gilbert, Bogle & Co., of Glasgow, successfully tried one of their electric launches on the Clyde at Kilcreggan. It was driven by Clarke's patent battery and motor, Mr. Clarke, the patentee, himself both managing machinery and steering the boat. The only others on board were Mr. Bogle and Major Macliver of Bristol and London, for whose inspection the trip was made. Clarke's patent dispenses with dynamo machines and accumulators, and enables the motion to be kept up by refilling the batteries with a simple chemical compound. In the smaller boats it is said a speed of five to seven miles is attainable, and Major Macliver, who had with him a 15-foot launch, built for him by Powell and Douglas, of Waukegan, Illinois, ordered it to be fitted with Clarke's machinery. If the experiment be successful, Messrs. Bogle were to construct a much larger vessel for him, which it is intended to take through the canals between the Rhine and the Danube next year, to make the trip from the German Ocean to the Black Sea. A large boat will be designed for a speed of 10 miles an hour, and will take several months to construct, but the smaller one will probably be seen on the Thames before the end of October.

The Electric Light for Photographic Printing.—A number of influential photographers from various parts visited the workshops of Mr. A. J. Jarman on Monday evening, to witness his method of employing the electric light for printing photographs from ordinary negatives upon sensitised albuminized paper. The apparatus consisted of two large reflectors of about 4 ft. in diameter, one inverted over the other, and separated from each other by about 12 inches between their extremities, with an arc lamp suspended in the centre. The printing frames were arranged sloping down the lower reflector, and all being ready, the arc light was put on of an actual 2,000 C.P., and it was found that photographs could be thus printed in half-an-hour equal to 20 minutes of ordinary daylight; but many expressed their opinion that if the sensitised paper was backed up with a pad containing carbonate of ammonia, the electrical method of printing would have an advantage over daylight. An incandescent lamp was placed upon a piece of the paper, exposed to the light, and a perfect negative of the bulb, carbon filament, and connection was produced in five minutes. Mr. Jarman's plan appears to be so successful that it bids fair to become largely adopted where photographs have to be turned out in large numbers during the dull days of winter. A single lamp will print 60 photographs of various sizes at the same time.

Telephone Companies and Property Owners.—In the City of London Court, on Friday of last week, an important case, involving the relative rights of property owners and telephone companies, was disposed of. The plaintiff was Mr. W. H. German, an independent gentleman, residing in Brighton, and owner of certain building land at Bow, and the defendants were the United Telephone Company, of 36, Coleman Street, City, who were sued for £50 damages for erecting posts and wires on the land in question without leave. Pending the hearing, Mr. Kebbell, solicitor, applied on behalf of the plaintiff for an injunction restraining the company from carrying out any further trespass. It was then held by Mr. Commissioner Kerr that according to English law an owner was entitled to the enjoyment of everything between his property and the heavens, and he asked why the plaintiff did not cut the wires? Mr. Kebbell replied that he purposely refrained from advising such a course, lest injury might accrue to life and limb; whereupon the learned Commissioner remarked that even in that event the plaintiff would not be liable to a charge of manslaughter; and considering the multiplicity of telephone wires recently erected it was desirable the public should know such was the fact. On the case being called last week, it was taken by Mr. T. Speechly, the Registrar of the Court. Mr. Purcell, barrister, who appeared for the company, stated that there need not be any further contention between the parties, as the posts and wires had been removed.

Mr. Kebbell: No doubt that is the fact; but I submit that all the circumstances of the case entitle the plaintiff to adequate damages, because the company have only lately agreed to make the amends which they ought to have done some months ago. Besides, when the plaintiff attempted to remove the posts, force was used to prevent him. The Registrar: Tell me of any actual damage which has been sustained, and I will deal with it. Mr. Kebbell: Surely a public company cannot commit a wrong of this sort against a private person, and maintain it till the last moment, without the law compelling them to give proper redress. The Registrar: You have not claimed for special damage. Mr. Kebbell: Well, my client had an opportunity of selling the land, and he could not carry out the bargain so long as the posts were up. That was certainly a hardship. The Registrar: But was he prevented from effecting a sale? Mr. Kebbell: I can't go so far as that. I have offered to take 20 guineas as damages. They have already offered £10. Mr. Purcell: I think the company acted in a very reasonable way. Only nominal damages can be recovered. The Registrar: I don't think the parties have been prejudiced at all. Mr. Kebbell: The learned Commissioner said if I proved my case, he would give me £50 damages per month. The Registrar: Are the company still prepared to give £10? Mr. Purcell: I don't know that. (Laughter.) The Registrar: Having made the offer, are you not bound by it? You have used this gentleman's land to a certain extent. How long were the wires up? Mr. Kebbell: Since February until within the last 48 hours. Mr. Purcell: We do not deny that we have committed a technical trespass; but that is all. Ultimately the Registrar fixed the damages at 40s., with costs on the higher scale. Mr. Kebbell: How about the costs of the application for an injunction? The Registrar: I shall deal with them on taxation. Mr. Kebbell: The worst feature of the case is that the company may erect the posts again to-morrow. It is not creditable to them to offer £10 and then withdraw it. The Registrar: On that I make no comment whatever.

Destruction of a Telegraph Cable.—The telegraph cable between Batavia and Telok Betong has been destroyed by the Java volcanic eruption.

The Silvertown Telegraph Works.—Monsieur le Comte d'Aunay, chargé d'affaires of France, Senor Don A. del Campillo, first Secretary of the Spanish legation, and Mr. Graves, the engineer-in-chief of the English Postal Telegraphs, accompanied by the directors of the Spanish National Submarine Telegraph Company, inspected, last week, the manufacture of the Cadiz-Canaries and Canaries-Senegal cables and also the two cable ships of the Silvertown Company, the *Dacia* and the *International*, which at present are shipping the cable at the Silvertown moorings.

Marine Surveying Expedition.—The French surveying vessel *Talisman*, Commander Parfait, returned to Rochefort on the 1st inst., after having taken 212 soundings and made 141 drags in the neighbourhood of the Canary Islands, Cape de Verde Islands, and the Azores. Mr. A. Milne Edwards was President of the scientific commission on board, and will shortly publish the results.

The Spanish National Submarine Telegraph Company.—Notice has been received from Madrid that the Minister of the Interior has granted an extension of time to the Spanish National Submarine Telegraph Company to carry out its concessions. We are informed that this extension was not obtained without some difficulty, as the Minister had received several anonymous letters, *some dating from London*, stating that the cables were not being constructed, and that the extension was desired only for a *coup de bourse.* The Minister, however, saw clearly that these letters could only emanate from opponents to his scheme, and consequently gave them the contempt they deserved.

A New Pacific Cable.—Mr. Sandford Fleming, C.M.G., the eminent Canadian civil engineer, is about to inspect Kamloops, in British Columbia, on the Pacific coast. The inspection is said to be connected with the scheme to lay a cable across the Pacific Ocean, between British Columbia and Japan, thereby securing a direct telegraph line from Europe to India, China, and Japan, over British territory. This scheme is steadily growing in favour, and is that which was embodied in a published letter of Mr. Fleming (who is engineer-in-chief of the Canadian Pacific Railway), dated Ottawa, 11th June, 1879, addressed to Mr. F. N. Gisborne, Superintendent Telegraph and Signal Service, Dominion of Canada, from which we take the following extract:—

> I am desirous of directing your attention to a project in connection with the Pacific Railway Telegraph, which appears to me of great national importance, which calls for careful consideration, and on which I do not doubt your great experience and ability can throw much light. The Pacific terminus of the Canadian Pacific Railway will, in all probability, be finally determinated this year, and the telegraph now erected from Lake Superior and carried almost to the base of the Rocky Mountains will then be extended to tide water in British Columbia. In my last report laid before Parliament, I submitted the importance of connecting Lake Superior with Ottawa, the seat of Government, by telegraph, and I have reason to believe that the Government favour the reasons I have expressed. If these connections are made we shall have a complete overland telegraph from the Atlantic to the Pacific coast. For the greater part of the distance the line will be wholly constructed by the Canadian Government, and there will be little difficulty on the part of the Government in securing from ocean to ocean complete control of the telegraph system. It appears to me to follow that, as a question of Imperial importance, the British possessions to the west of the Pacific Ocean should be connected by submarine cable with the Canadian line. Great Britain would then be brought into direct communication with all her greatest colonies and dependencies without passing through foreign countries. The telegraph system of Europe is now extended easterly through Russia to the eastern coast of Asia. A second line follows the route by the Red Sea to India, China, and Japan, with a branch to Australia, and certainly some of these points could be connected with the Pacific shores of Canada, and thence with the great cities on both sides of the Atlantic, much more directly than they now are. Moreover, a submarine telegraph from the western coast of Canada to Asia, in continuation of the Pacific Railway line, while completely girdling the globe by an electric wire, would connect with the Australian and New Zealand branch, and without question would extend the most important advantages to the whole outer empire of Great Britain. . . . I beg to ask you to give your earnest attention to the scheme.

The Telegraph in China.—It is announced that telegraphic communication between Pekin and Canton is to be shortly established. Several engineers have arrived at Shanghai, who will proceed to Souchou for the purpose of superintending the works, which will be executed by MM. Wong, Moller, Colding, and Ulm-Lee, under the protection of the Chinese troops.

Personal.—It is reported that Mr. Hiram S. Maxim has been elected consulting electrician to the Maxim-Weston Electric Light Company.

Telegraphic Communication.—Telegraphic communication is now established between Qu'Appelle and Battleford through the Temperance Colony, and an office will be opened shortly at Telegraph Crossing in the Colony.

The American Telegraphists' Strike.—In connection with the strike of the American telegraphists, a deputation of the telegraph operators of the Canadian Grand Trunk Railway have laid before the manager a statement of grievances for which they ask redress. An increase of salary is asked, and a double rate of pay for Sunday labour.

These Overhead Wires Again!—The helplessness of London in the matter of overhead telephone wires is, says the *Pall Mall Gazette*, a public scandal. Every day some addition is made to the number of overhead wires, every week some vestry complains, but nothing is done. Legislation is necessary, but legislation is impossible for six months, and when Parliament was sitting no steps were taken to provide a speedy and effectual remedy for this great and growing evil. Before long, our leading thoroughfares will be literally wired in, and Londoners will live and move and have their being in a kind of gigantic birdcage, the wires of which may snap at any moment and injure or decapitate those upon whom they fall.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

London and Provincial Electric Lighting and Power Generating Company, Limited.—The annual return of this company, made up to the 31st ult., was filed on the 10th inst. The nominal capital is £250,000, in £5 shares. 13,813 shares have been taken up, and the full amount has been called up thereon. The calls paid amount to £65,643, leaving £3,422 unpaid. Registered office : 21, Great Winchester Street, E.C.

Electric News Telegraph Company, Limited.—The annual return of this company, made up to the 3rd inst., was filed on the 8th inst. The nominal capital is £150,000, in £5 shares. 7,805 shares have been taken up, and the full amount has been called thereon, the calls paid amounting to £38,842 10s., leaving £182 10s. unpaid. Registered office : 4, Ludgate Circus.

Electro-Amalgamator Company, Limited (Barker's Patent).—An agreement, dated 4th inst., registered on the 7th inst., states that letters patent for certain countries have been taken by Mr. W. J. Tanner, for the benefit of the company, for inventions relating to the disintegrating ores by means of electricity, and also for the use of amalgam plates with electricity.

St. George Telephone Company, Limited.—At extraordinary general meetings of the members of this company, held at 80, Coleman Street, on the 15th and 31st ult., the following resolution was passed and confirmed, viz. :—"That, pursuant to the powers contained in the Memorandum and Articles of Association, 6,000 of the unissued shares be issued by the company as preference shares, entitled to a preferential dividend of £7 per cent. per annum in priority to all ordinary shares, and in the event of a distribution of the capital and assets of the company, the said shares be also entitled to have the whole of the capital representing the same duly paid, in priority to the ordinary capital of the company.

Lyons Electrical Power Storage Company, Limited.—The first return of this company, made up to the 31st ult., was filed on the 4th inst. The nominal capital is £400,000, in £1 shares. 80,037 shares have been issued, and 10s. per share has been called, the calls paid amounting to £80,005, leaving £32,013 10s. unpaid. 50,000 shares, considered as fully paid, have been allotted to the vendor. Registered office : 3, Copthall Buildings.

CITY NOTES, REPORTS, MEETINGS, &c.

The Spanish National Submarine Telegraph Company, Limited.

THE first meeting of the shareholders of this company was held on Monday, Mr. H. Owen Lewis presiding.

The Secretary, Mr. W. J. Tyler, read the notice convening the meeting and also the directors' report, which was as follows :—

"The directors have to report that in May and July last they contracted with the India Rubber, Gutta Percha, and Telegraph Works Company, Limited, for the manufacture and laying of cables (1) to connect Cadiz with Teneriffe, Gran Canaria, La Palma, and Lanzarote in the Canary Islands, and (2) Teneriffe with the port of St. Louis in Senegal, measuring respectively about 1,020 and 900 nautical miles. The first-mentioned cables will be laid under a Spanish Government concession of the 3rd of January last. The manufacture is completed, the shipment nearly so; and the contractors' vessels are to leave London on the 18th instant. The line will probably be opened to the public in the first days of November. Thereupon the first instalment of an annual subvention of about £20,000 a year for ten years will become payable to the company by the Spanish Government. The Senegal cable will be laid under an agreement of the 11th of June last, by which the French Government is to contribute £68,000 towards the cost of the cable. 150 nautical miles are already manufactured; and the contractors expect that the line will be laid and at work by the end of the year. Yesterday, the directors visited the contractors' works and vessels at Silvertown, accompanied by Count d'Aunay, Chargé d'Affaires for France, Señor Don del Campillo, Spanish Secretary of Legation, Mr. Graves, Engineer-in-chief, British Postal Telegraphs, and several officials of the French and Spanish telegraph services. The various processes of the manufacture and shipment of this company's cables were inspected by the visitors with much interest; and the shareholders may rest assured that the work undertaken by the contractors will be efficiently carried out."

On the motion of the Chairman, seconded by Mr. F. Anderson, the report was adopted.

The Telephone Company of Ireland, Limited.

ON Friday of last week the half-yearly meeting of the proprietors was held at the offices of the company, Commercial Buildings, Dame Street, Dublin, Mr. E. D. Gray, M.P., presiding.

The Secretary (Mr. J. P. Butterworth) read the notice convening the meeting, and also the directors' report, which we published in our last issue.

The Chairman, in moving the adoption of the report and statement of accounts, congratulated the shareholders on the very prosperous condition of the affairs of the company. There had been a steady monthly progress, both in the number of exchange subscribers and in the number of renters of private wires, and at present the number of the former was about 450, and of the latter 130. The company's net profit, including the proportion of royalties to the United Telephone Company, overcharged in the previous half-year, and brought forward to credit, £329, amounted for the five months, over which the report extended, to £624. The amount required for the payment of the 6 per cent. dividend was £306, which left them a balance of profit of over £300. The amount which would be required for the succeeding six months to pay dividend upon the preference shares was only £375, so that thus they had practically carried forward from the five months sufficient to pay their dividend for the succeeding half-year; and, he might say roughly, that the earnings represented something about 12 per cent. instead of 6. Therefore he thought that the preference shareholders so far at least had reason to say that the directors had taken fair care of their interests. Certain arrangements had been concluded with the Corporation and other bodies, and in a short time they expected to have the whole city connected by telephone. The question of trunk wires, which was a very important one, had occupied the attention of the directors, and he saw no reason whatever why within a short time they should not be able, to the great advantage of the public and the benefit of the companies concerned, to establish a trunk wire between Dublin and Belfast, so that any person in Dublin who subscribed should be able to speak personally to his correspondent in Belfast; and he believed, probably in a short time, the system would so develop that they might be able to establish trunk wires with other important cities.

Mr. Patrick Gordon seconded, and the report and accounts were adopted.

On the motion of the Chairman, seconded by Mr. P. Cummins, it was agreed :—"That a dividend for the five months ending the 30th June, at the rate of 6 per cent. per annum, upon the amounts paid upon the preferred shares be, and the same is, hereby declared payable."

The meeting was then resolved into an extraordinary general meeting, when

The Chairman moved resolutions authorising the directors to issue 50,000 preference shares of £1 each, upon the terms of the Articles of Association, and to exchange all or any portion of the existing 6 per cent. preference shares for 5 per cent. preference shares of the new issue at the rate of 100 of the 6 per cent. preference shares, with 10s. per share paid, for 120 of the 5 per cent. preference shares, to be credited with 10s. per share paid. They did not suggest, he said, to reduce the amount of interest which they were at present receiving upon their money, because they proposed to give by way of bonus upon the conversion 20 per cent. in shares. The liability, in the event of more money being required for the purpose of the company, would be increased from £50 unpaid to £60 unpaid. They considered that each shareholder would reap an advantage in the market value of his shares, and that £60 of 5 per cent. stock would be likely to sell in the market for more than £50 of 6 per cent. stock. That was one reason which had influenced the directors in making this recommendation, and another was that, as they were aware, they applied for and were refused a settlement upon the Dublin Stock Exchange. They were in hopes that if they increased their preferential capital to £50,000 they would be able to obtain a quotation upon the Dublin Stock Exchange, and they were also in hopes that if they failed upon the Dublin Stock Exchange they might be able to obtain it on the London Stock Exchange. Whatever decision they came to would not bind them absolutely, as a subsequent meeting must be held to ratify or reject the resolutions they passed that day.

Mr. Mooney seconded.

Mr. Thomas Mayne, M.P., maintained that the important change which was proposed was, in the first place, unnecessary at present, that in the second place it was unwise, and that in the third place it would be unsuccessful—unsuccessful, he meant, with reference to the views which were put forward as the principal reasons why the change was sought to be made.

After a short discussion the resolution was put to the meeting, and carried without dissent.

The meeting adjourned.

The United Telephone Company, Limited.—Application has been made to the Stock Exchange Committee to appoint a settling day in the 20,000 new shares of this company, and allow the same to be quoted in the official list, and to allow the $5,000,000 5 per cent. bonds of the Long Island Railway Company to be officially quoted.

The Eastern Telegraph Company, Limited.—Mr. John Pender, M.P., chairman of this company, accompanied by Sir James Anderson, the managing director, has started for the Mediterranean and the Levant, on a tour of inspection of the various telegraph stations belonging to the company in those waters.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotatns, Sept. 12.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	7	2⅛-2⅞	
		Do. Do.	10	5¾- 6¼	
30,000	5	Australasian E. L., Power & Storage Co.	3	⅛- ⅜	
24,900	10	British Insulite Co., Ld., "A" Shares..	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	½- ¾	
25,000	5	Gt. Western Electric Light & Power Co.	2½	⅜- ⅝	
24,980	5	Hammond Elec. Lt, & Power Sply. Co.	2½	1 - 1¼	
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
172,500	1	Maxim-Weston Elec. Lt. & Power Co. .	1	1/16- 3/16	
..	..	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2	..	
..	..	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	1¾- 2	
		TELEGRAPHS.			
2,116,400*l*.	Stk.	Anglo-American, Limited	100	47½- 48½	47-¼-⅞*a*.
2,441,800*l*	Stk.	Do. Pref. } Def. receiving no div. until	100	79½- 80½	80-79⅞*a*.
2,441,800*l*	Stk.	Do. Def. } 6 p. c. paid to Pref.........	100	17 - 17½	
130,000	10	Brazilian Submarine, Limited	10	10 - 11⅜	
16,000	10	Cuba, Limited	10	10½- 11	
6,000	10	Do. 10 per cent. Preference ..	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	5 - 5½	
6,000	10	Do. 10 per cent. Preference ..	10	15¾- 16¼	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	12⅜- 12⅞	
100,000*l*.	100	Do. 6 per cent. Deb., repayable 1884	100	101 -103	
380,000	10	Eastern, Limited	10	10⅜- 10⅞	10 13/16*a*.
70,000	10	Do. 6 per cent. Preference............	10	10 - 12¾	13 7/16.
232,000*l*.	100	Do. 6 do. Debs., repayable Oct. 1883	100	100-102	
200,000*l*.	100	Do. 5 do. do. Aug. 1887	100	101-103	
200,000*l*.	100	Do. 5 do. do. Aug. 1899	100	103-107	
199,750	10	Eastern Exten., Australasia & China, L.	10	11⅛- 11⅜	11⅜*a*.
320,000	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	106- 109	107½*m*.
500,000	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102- 106	
140,000	100	Do. do. reg., repayable 1900..	100	102- 106	
100,000*l*.	100	Do. 5 per cent. Debenture, 1890	100	102- 105	
254,300*l*.	100	{ Eastern & South African, Ld., 5 p. c. } { Mort. Deb. Rg. redeemable 1 Jan. 1900 }	100	102- 105	
345,700*l*.	100	Do. do. do. To Bearer..	100	101- 104	
22,050	10	German Union Telegraph & Trust, Ld.	10	9¾- 10¼	
163,390	10	Globe Telegraph & Trust, Ld.	10	7⅜- 7⅝	7 9/16*a*.
163,209	10	Do. 6 per cent. Preference	10	12¾- 13	12¾*m*-12 15/16*a*.
125,000	10	Great Northern	10	12¾- 13	
100,000*l*.	100	Do. 5 per cent. Debentures ..	100	100 -102	
300,000	100	Do. 5 per cent. Debentures ..	100	100 -102	
31,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	29½- 30½	
100,000	100	Do. 6 per cent. Debs., 1886	100	103-106	
17,000	25	Indo-European, Limited	25	31 - 32	
38,148	10	London Platino-Brazilian, Limited ...	10	3½- 4	
12,000	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	2 - 4	
9,000	8	Reuter's, Limited	8	8½- 9	
280,000	Stk.	Submarine	100	220 -230	
58,225	1	Do. Scrip	1	1⅞- 2⅛	
4,200	Cert.	Submarine Cables Trust	100	105 -108	
37,350	12	Telegraph Construction and Mainten.	12	33 - 34	32½*a*.
150,000	100	Do. 6 per cent. Bonds, 1884 ..	100	101 -103	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅝- 1⅞	
30,000	10	West Coast of America, Limited	10	4¾- 5¼	
150,000	100	Do. 8 per cent. Debs.	100	104 -107	
69,910	20	Western and Brazilian, Limited	15	5⅞- 6⅛	
		Do. Preferred	7½	4¾- 5¼	
		Do. Deferred	7½	1 - 1¼	
200,000*l*.	100	Do. 6 p. c.. Debs. "A" 1910 ..	100	102 -106	
2,500	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	95 - 98	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	122 -124	
1,080,000*l*.	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	¾- 1	
34,563	10	Do. 6 per cent. 1st Preference	10	6¼- 6¾	
4,669	10	Do. 6 do. 2nd do. ..	10	4¾- 5¼	
		TELEPHONES.			
154,165	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	¼- ½	
200,000	1	Oriental Tele. Co., Nos. 80.001 to 300,000	½	¼- [illegible]	
100,000	5	United Telephone Co.	5	8 - 8½	

NEW PATENTS—1883.

4269. "Electric lamps." A. W. RICHARDSON. Dated September 5.

4276. "Electrical switches, chiefly designed for use with telephonic apparatus." H. H. LAKE. (Communicated by C. W. Holden.) Dated September 5.

4281. "Electric lamps." J. R. P. WALLACE and F. CHERRY. Dated September 6.

4297. "Supports or holders for telephone or other instruments." H. H. LAKE. (Communicated by C. W. Holden.) Dated September 6.

4298. "Telephonic apparatus." E. GEORGE, F. A. POCOCK, J. S. and J. S. MUIR. Dated September 7. (*Complete.*)

4319. "Electrical generators." F. C. GLASER. (Communicated by A. G. Gravier and Messrs. Kuksz, Luedtke and Grether.) Dated September 8.

4345. "Galvanic batteries." E. P. CHAIMSONOVITZ and S. ROWAN. Dated September 11.

4347. "Means and appliances for operating safety signals and other devices on railways electrically and otherwise." T. A. B. PUTNAM. Dated September 11.

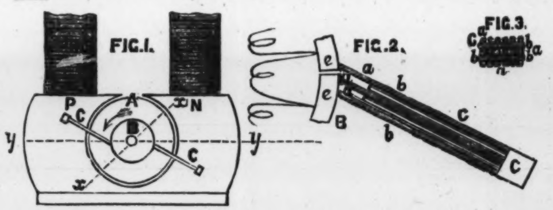
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

5910. "Electric lamps." F. H. F. ENGEL. (A communication by F. Küppermann, of Hamburg.) Dated Dec. 11. 2d. Relates to certain improvements in mechanism and in fitting up the parts for regulating the distance apart of the electrodes of electric arc lamps, and has for its object to secure a more uniform working of such lamps than heretofore. (*Provisional only.*)

6034. "Photometric Apparatus." S. P. THOMPSON and C. C. STARLING. Dated Dec. 18. 2d. Relates to improvements in photometric apparatus, and consists in the employment of interchangeable opaque screens in ascertaining or comparing the intensity of lights. These screens are formed of two members, either plain or coloured, and attached to one another at any desired angle, the double screens thus formed resembling wedges, having the ends opposite the apex open, to admit of their being placed on a support, either fixed to or adjustable upon the horizontal bar of the photometer. The bracket carrying the candles may be either fixed to, or adjustable on, the bar, which is graduated on the proper portion of its upper face, according to the law of universe squares, or the scale may be formed independently of the bar, and applied or attached thereto. The light from the candles is directed upon one face of the double screen, and, in measuring lights below a certain intensity, the rays of the light to be measured are directed upon the opposite face of the double screen, the light being carried in a bracket either fixed to, or adjustable on, the bar. (*Provisional only.*)

6150. "Automatic electric signalling apparatus for railways, &c." H. J. HADDAN. (A communication from abroad by P. H. Fortin and J. J. Langlet, of Paris.) Dated Dec. 23. 2d. Relates to automatic electric signalling apparatus for establishing communication between different stations of a railway; it is also applicable to mines and other industrial establishments. (*Provisional only*).

6183. "Electrical generators and motors." T. J. HANDFORD. (A communication from abroad by T. A. Edison, of America.) Dated Dec. 27. 6d. Has for its object the production of means whereby the current collectors, or commutator brushes may be retained at the points of maximum electromotive force or work of the generator or motor, without undue or destructive sparking, the capacity of the machines being thereby largely increased. In carrying out the said invention the current collectors, whether in the form of wire brushes, plate springs, or of other form, are made of some metal or alloy having inferior conductivity, and making inferior contact compared with copper, and preferably having a high melting point. Nickel, iron, steel, cobalt, platinum, or palladium may be used, or alloys such for example as phosphor-bronze or brass, but it is preferred to use German silver for the purpose, for the reason that it offers very great resistance, and does not lose its stiffness by heat as is the case with most alloys. Fig. 1, illustrates a part of a dynamo-electric machine, or electro-dynamic motor, with commutator brushes, arranged in accordance with the said invention; fig. 2, a view on a larger scale of two bars of a commutator and the improved brush; fig. 4, a cross section of the brush. P, N (fig. 1), are the polar extensions of the field magnet of the generator or motor, A, being the armature, B, the commutator cylinder, and C, C, the commutator brushes. The varying neutral line on the commutator cylinder is represented by the dotted line, *x*, *x*, and the line of maximum electromotive force by the dotted line, *y*, *y*. Heretofore in order to prevent sparking it has been found necessary to shift the brushes on to the line, *x*, *x*, but it is possible by reason of the peculiar construction and arrangement of the current collectors, or commutator brushes according to the said invention, to keep them on the line, *y*, *y*, without sparking. Two or more commutator brushes connected together are used on each side of the commutator cylinder to carry the current, as shown in fig. 2. Each brush is constructed of layers of wires, *a* (figs. 3 and 4), of German silver, or other inferior conducting metal or alloy, the layers being divided by metal plates or strips, *b*. The wires, *a*, and plates, *b*, are formed into a solid mass by soldering at the outer end, *c*, of the brush. The plates, *b*, are japanned as are also the wires, *a*, so as to insure a good electrical division of the brush. The brush rests with the ends of all its wires bearing on the commutator cylinder as shown.



TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

CORRESPONDENCE.

Electrical Boats driven by Batteries.

In Mr. Toynbee's description of the voyage of the *De La Motte* from London Bridge to Hammersmith and back, on page 152, he does not state how often he tacked across the river to make a 20 miles' run of it. He is to be complimented upon having made a new departure in nautical description, for instance, "one mile in 11 minutes" savours rather of the "sporting reporter" than the scientific description of a trial trip. It is certainly not usual to note the draught aft and "midship" and neglect the forward draught altogether, and that the "midship is nearly as wide at the top as it is at the bottom," is rather vague.

He is very kind in drawing the attention of others, who, though less famous, are like him, interested in electrical navigation, to the fact that roller bearings reduce friction and add to the general efficiency. I fear, however, that he "strains the gnat, and swallows the camel," and saves five per cent. in his bearings and loses 50 on his motor.

I cannot see how the current from 58 Bunsen cells passing through a *constant* resistance of 13 ohms for 10 hours can be compared to the same current driving a motor for the same time? Has Mr. Toynbee ever heard of "counter-electromotive force"? Probably, as his motor only makes 256 revolutions per minute, he does not consider it a necessary factor in his calculations.

Frederick Walker.

Sept. 6th, 1883.

The "Hammer" Telephone.

I am pleased to find so much interest taken in the new theory, by which I have explained the working of the "Hammer" Telephone. After my first experiments I was convinced, in my own mind, that the undulatory current theory of Prof. Bell could not account for the telephonic transmission in my instrument, but I foresaw the objections which had to be encountered by a new idea in direct contradiction to those generally held.

So I have varied and multiplied my experiments in every possible manner in order to dissipate the last doubts that might remain; and it is only after having observed the perfect harmony of the results of all these experiments that I have confidently determined to formulate my theory.

I intend to publish shortly a complete work on the subject; but I do not wish to leave, without an immediate answer, the five questions which Mr. F. W. Cooke asks in the ELECTRICAL REVIEW for Sept. 1st. It would be difficult to condense the objections to my theory in a better manner than does this correspondent. I thank him for the interest which he takes in the success of my telephone; I hope that the replies which I am about to make to his questions will satisfy him entirely.

"*What constitutes a flexible organ?*"

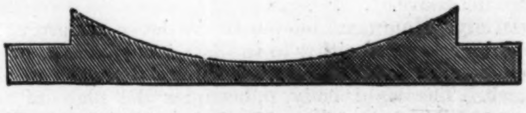
I answer:—The flexibility of a body is the property, in virtue of which certain parts of this body may, under the influence of a slight force, undergo displacements relative to other fixed parts of the body and, after the action of the force ceases, return to the original position, after some oscillation.

Every straight or spiral spring constitutes an eminently flexible organ—a thin stretched membrane constitutes a flexible organ in which the oscillations are tympanic, that is to say, it is no longer an extremity, but the centre of the membrane which undergoes displacement. For the membrane we may substitute a thin disc as in the Bell telephone, without destroying its flexibility. But in proportion as the thickness of this disc is increased, its suppleness and its flexibility, which are the same, diminish, until we obtain a piece *practically* inflexible. When, for the thin and flexible iron plate of the Bell telephone, we substitute a plate only $\frac{1}{10}$ of an inch thick, the effect in the telephone is almost nothing. This is a fact which cannot be, and is not, disputed by anyone.

Now for the "Hammer" telephone, in which the contrary takes place. When we diminish the thickness of the organ against which the hammer rests, that is to say, when we transform this organ into a supple and flexible piece the effect of the apparatus is considerably lessened. It is when this organ has a minimum thickness of $\frac{1}{10}$ inch, that is to say, when this piece is *practically* inflexible, that the effect is at the maximum. This clearly shows that the production of sound is not due to a series of deflexions of the organ.

On the other hand, when we attach to the rigid piece the extremity of the lever armature, the sound is nearly destroyed.

We could not certainly say that a wooden piece of the form represented in section—natural size—in the accompanying sketch, and which would suit perfectly as the organ for receiving the shock in my telephone, is accurately described as I have made it, as a *rigid inflexible piece.*



The qualification *inflexible*, as I have employed it, is therefore appropriated to the organ indicated, and it should be taken in the ordinary and practical sense attached to this word. This is my reply to the first question. I now come to the second.

"Under what conditions are wood, glass, or ebonite unsusceptible of undulatory movements, as these substances under ordinary circumstances possess the two essential properties for the propagation of sound, viz.: elasticity and density?"

I have never pretended that wood, glass, and ebonite were incapable of undulatory movements; what I said, and what I consider correct is, that in the arrangement given in my telephone, these undulations can only have a duration and amplitude infinitely small compared with those of the sound-waves of the air, and that, consequently, these materials are not susceptible of *the undulatory* movements which are, according to the theory of Bell, the reproduction or the fac-simile of the sound-waves of the air.

I pass on to the third question.

"Assuming D to be thick, rigid, inflexible, and unsusceptible of undulatory movement, by what process are the impulses, or, as M. De Locht-Labye puts it, sudden shocks, conveyed to the lever, L, when the instrument is used as a transmitter?"

I reply that this transmission is made by a phenomenon analogous to the well known phenomena of ivory billiard balls. I find a note upon these phenomena in the journal *Cosmos les Mondes* (January 13, 1883, page 49), by M. le Capitaine Tréves, communicated to l'Academie des Sciences. I extract the following paragraphs from it, which are conclusive for explaining the transmission of the sound-shock in my telephone employed as a transmitter.

"Here we have suspended from a common support several equal-sized ivory billiard balls, in contact and ranged in a straight line; let us call them, starting from the left, A, B, C, D, E, for instance.

"We withdraw the first, A, to any angle whatever, and let it fall. It strikes the next ball, B, then it remains at rest, having given up all its velocity to B, which transmits it to the third, C, and, finally, from ball to ball to the last one, which raises itself and falls again with the same velocity as had at first, A.

"That which is most striking in this experiment is the *absolute immobility* of the three intermediate balls, B, C, D, which only serve to transmit the movement from the first ball, A, to the fifth, E, and reciprocally. The two last balls move as if there was nothing between them—as if they were alone. The three intermediate balls form like a conductor of energy, but they can only play such a part by storing up successively the quantity of movement imparted to the first ball, A. There is no effect without cause; each of the intermediate balls *in its immobility must* be the seat of a special movement, which we can prove by an extremely simple process. For this purpose I cover abundantly, with any metallic filings whatever, the upper part of all the balls, then I proceed as before.

"What happens?

"Let us observe the central ball, C, for instance. The filings do not *incline* to the right or to the left, as we might have imagined, under the influence of a vibratory motion, '*foreseen*,' although useless. The filings accumulated upon this *absolutely motionless* body are strongly *projected* in the direction of the shock, or, rather, of the dynamic current. . . . .

". . . . We remark besides this other interesting phenomenon. There is no projection of *all* the filings heaped around the point of suspension of each ball. It is only *the half*, and this that which is upon the opposite side from the shock. Thus, if it takes place from A to E, that is to say, from left to right, it is always the filings on the right portion of each ball which are strongly projected towards E; the other mass of filings does not move. . . . ."

In my "Hammer" telephone the lever armature, E, may be compared either to the last ivory ball, E, or to the metallic filings projected in the direction of the shock. The rigid body, D, occupies the place of the intermediate balls. The sound wave in striking the rigid body fulfils the office of the ball, A. It follows then that the intermediate *rigid body*, D, remains *apparently absolutely* motionless, communicating motion to the armature lever, L, which is momentarily separated.

It is besides well established in mechanics that when a body possessing a certain quantity of movement encounters another it imparts to it all or part of its force, and provokes the movement of the body struck if that is relatively more mobile than the first. The transmission of motion from the string of a bow to the arrow furnishes a striking example, very similar to the action of transmission in my telephone.

I think that the explanation of this phenomenon has been formulated in terms sufficiently clear so that more would be superfluous.

Mr. Cooke then asks me:

"Supposing L to have received a given number of shocks of a certain intensity, say a musical note produced by the human voice, how does it (the lever) discriminate between this and the same note of equal intensity, sounded on a violin; in other words, how is the timbre transmitted?"

It is very easy for me to answer this question. It is now well established in physics, that the *timbre* of a sound is due to the co-existence with the fundamental sound of other sounds called *harmonics*. But these could be as perfectly transmitted by the aid of my telephone by sudden shocks equal in number with the vibrations which constitute these secondary sounds, as the shocks which characterise by their number the fundamental sound. It is, therefore, evident that my telephone can receive and transmit sounds emitted by various sources and preserve all their qualities.

Lastly—"Since all the movements are sudden and in no way possess a duration equal to that of a sound-wave of air, how is the sound-wave reproduced at the receiving end?"

It is not recognised or established in physics that, between the source, the origin of a phenomenon and its manifestation or its reproduction at a distance, all the characteristics peculiar to this phenomenon must have been preserved. The contrary is most often the case. Thus, does not the luminous *ray* which passes from one medium into another undergo *refraction* and *dispersion*, that is to say, modification of its direction and its colouration? and when it passes again through a medium of the same nature as the first, does it not resume its original form, that is to say, a direction parallel to the first and a colouration similar to that which it had at first?

Is not reversibility of phenomena recognised as an almost general fact in every branch of physics? Thermodynamics is founded upon the principle of the reciprocal transformation of sensible heat into mechanical motion, and of external work into caloric. The transmission of power to a distance by dynamo-electric machines is, moreover, a remarkable example of this fact of the successive transformations of the manifestations of a force in such a manner as to produce as a result *phenomena identical in nature with those which were originally produced.*

As for the transmission of sound through various media, it is easily explained. The propagation of the sound in these media is not produced in the same manner. The speed of propagation by solids is from 10 to 15 times that of the propagation by gas. It is quite evident that the duration and amplitude of the vibrations is altogether different. But there is nothing to prevent the sonorous vibration, in being communicated from a gaseous to a solid medium, changing its character and after being propagated according to a special law in the whole extent of this solid, returning to the air and resuming the characteristic properties of its transmission through this medium, and consequently producing upon our auditive sense a similar impression to that which would be produced by direct transmission. It is the same with the mechanical phenomenon of the ivory billiard balls of which the last, E, receives from the ball A—notwithstanding the intermediate balls—motion *apparentlg identical* with that which would have resulted from a direct shock.

My replies to the questions proposed by Mr. F. W. Cooke is, I think, as complete and categorical as could be desired. Evidently each of these ideas could be developed, but I fear I have already given them at too great a length.

Leon De Locht-Labye.

Liêge, *Sept. 2nd*, 1883.

Wonderful Inventions.

For some time past my brain has been severely exercised—my nights almost sleepless—working out what, I think, I may term a wonderful discovery; and by dint of much manual labour in my laboratory, I have perfected an instrument, the importance of which language cannot exaggerate; but, alas! all my cherished hopes of being the first inventor of an instrument which would astonish the world and make my name famous now and for ever, seem to be threatened with annihilation, and I fear I am a disappointed inventor. My dismay was caused upon reading the description of the performances of a new telephone published lately in one of the daily newspapers, but more especially by the announcement that another new invention, by the same person, is expected, as promised in the last paragraph of the inclosed slip from that newspaper:—

> "A NEW TELEPHONE.—More than one severe test has been applied lately to an improved telephone which has been invented by Mr. Arthur St. George, and which bears the name of the inventor. Mr. St. George claims for his instrument advantages far superior to those attaching to any other telephone, and as his invention has now been patented, the public can judge of its merits. Supplementary to the telephone itself is a contrivance of a very remarkable character, which Mr. St. George claims to have perfected so that it will not only record every description of conversation carried on through the instrument, but will reproduce the words at any future time. The importance of such an invention can hardly be over-estimated. Briefly stated, the contrivance may be thus described: A circular plate of glass is coated with collodion and made sensitive as a photographic plate. This is placed in a dark box, in which is a slit to admit a ray of light. In front of the glass is the telephone diaphragm, which, by its vibrations, opens and closes a small shutter, through which a beam of light is constantly passing and imprinting a dark line on the glass. Vibrations of the shutter cause the dark line to vary in thickness according to the tones of the voice. The glass plate is revolved by clockwork, and the conversation as it leaves the telephone is recorded on the sensitive plate, the words spoken being fixed as is done in photography. The plate can be brought forward afterwards, and when replaced in the

machine and connected with a distant telephone will, when set in motion, give back the original conversation. It seems impossible to exaggerate the importance of this discovery. With telegraphic messages, the substance is recorded, and can be referred to in case of dispute; but with the telephone, as now used, conversation like that of every-day life is necessarily subject to misapprehension and dispute, and no means exist of verifying the accuracy of what has passed between the speakers. Mr. St. George's invention appears to supply what is wanting, and will probably prove invaluable to all persons who may desire at a future time to verify his 'word of mouth.' We believe that there are other points connected with these discoveries which are new to electrical science, and almost as wonderful as that which we have described; while another invention is about to be patented which is expected to cause greater surprise than the means of photographing telephonic conversation."

It sometimes happens that two inventors make the same discovery; for instance, the telephone, discovered by Reis and by Bell; but, unfortunately for the latter, Reis' telephone was invented and descriptions of it published in 1862, which descriptions were in Bell's possession long before Bell made *his* wonderful discovery.

As I fear I may lose the fame of making this discovery and also the unbounded wealth that it might bring to me, I shall endeavour to secure to me the former and abandon the promised wealth; I therefore send you a statement of what my invention in its present state performs, witholding, however, for the moment the means I employ to produce these wonderful results.

My instrument is a combination speaking and writing telephone, of the utmost simplicity of construction. The instrument is inclosed in a box, having a lid which falls down to disclose the diaphragm by touching a little knob at the end of two conductors; the box can be placed in any position at any part of a room, however large it may be, provided there be nothing between it and the voice of the speaker. The instruments at both ends of the circuit are identical. This instrument will reproduce in a loud full tone the slightest whisper. It will also record in shorthand characters simultaneously at the receiving and transmitting end with the greatest accuracy. I will not withhold the fact that the record is made on a narrow band of a compound material. This band, by reversing the action of the instrument, can thus be made to pass through the instrument and the words of the speaker will be reproduced at that end on similar bands and on as many similar instruments as are placed in the same circuit, and the band can be kept as a record of the words spoken. I omitted to say that I dispense with a call bell, as the instrument speaks loud enough to be heard by anyone (not deaf) in the room, and it also has an attachment, not larger than a lady's thimble, constructed especially to repeat the word "Hallo" sufficiently loud to be heard throughout any ordinary sized house.

I am now working hard, night and day, in perfecting an attachment by which the words of the speaker will be recorded in his handwriting instead of in shorthand characters. I hope to have the instrument perfected in a few days, when I shall send you a full description of it, fondly hoping that no other inventor will attempt to deprive me of the fame due to me by publishing in the meantime to the world a similar invention.

Modesty.

Patents for Telephones.

"Every man has his price!" This saying of the famous French statesman has been forcibly recalled to my mind by the perusal of your correspondent's (W. C. Barney) letter, published in your REVIEW of the 8th instant. What *good* and *weighty* reasons your correspondent has for the great change in his opinion as to the claims of the Bell patent, he does not vouchsafe to give, but he leaves your readers to surmises. Can it be, now that he has sold his patents to the United Telephone Company against which he has been so prolific in his communications to the REVIEW, that he follows the example of others who have patented inventions for telephones—which they claimed to be superior to those of Bell or Edison—and with which they threatened to destroy the monopoly claimed by the United Telephone Company, against which they were hard in their condemnation, and after having sold their inventions to the much-abused monopolists, became suddenly convinced of their previous "cussedness," and are now faithful defenders of the claims of the monopolists to "every form of magneto-telephone," and to "every form of transmitter in which carbon or any equivalent substance is employed."

Your correspondent concluded his letter with the following sentence:—"I will simply remark that a diaphragm of any material which is stiff, or which is rendered stiff by any process, having attached to it any material capable of inductive or magnetic action, placed in front of the pole of a magnet, comes clearly within Bell's patent."

How does this opinion of your correspondent comport with his many previous statements? Has he not heretofore many times cited the judgment of Mr. Justice Fry and of the Master of the Rolls, that Bell's claim was a diaphragm capable of inductive action placed in front of the pole of a magnet, *only* when the diaphragm is held down all round its edge. A change seems to have come over his dreams; for in his latest communication to the REVIEW he omits that important feature that the diaphragm must be held down all round its edge; and he claims for the Bell patent the exclusive use of any such diaphragm in front of the pole of a magnet. Perhaps the memory of your correspondent is like what the Master of the Rolls said of Sir William Thomson's—"it cannot be relied on." I will ask your correspondent whether the famous Glasgow receiver, with its plate capable of inductive action in front of the pole of a magnet, is not covered by this latest definition by him of Bell's claim? I might perhaps anticipate that his reply will be—(in the language of one of his Latin quotations of which he seems so fond)—*tempora mutantur et nos mutamur cum illis.*

Inquirer.

Allow me to thank you on behalf of the inventive public for your remarks at the end of Mr. Barney's letter on the above subject. Permit me also to add another proposition, which that gentleman appears to have altogether ignored, viz., that *a new combination of old parts constitutes good subject matter for a valid claim.* I do not intend to argue with Mr. Barney the question of the validity of the patents to which he refers, as the proprietors of those patents are, no doubt, quite capable of defending their own interests, but I cannot forbear offering a word of advice to that gentleman, that before he again attempts to air his knowledge of patent matters, he should first inform himself on the axioms and rudimentary principles of patent law and practice, and thus avoid in future the well-merited rebukes to which his epistolary effusions so frequently expose him.

Observer.

Patent Rights and Wrongs.

It would be difficult, if not impracticable, for any Government to establish a satisfactory system of protection against the piracy or infringement of patents. Yet, probably, there could not have been a system more worthless and indefensible than that involved in the late Patents Act—in fact, I may add, there is scarcely any industrial measure that leaves the hands of the Legislature, composed, as this is, of a great proportion of the disciples of Thomas, directly and indirectly, that is not loaded, in its practical issues, with costly litigation, in which in too many melancholy cases the poor inventor is utterly powerless to contend against the wealthy infringer and culprit.

In order to illustrate the profitable confusion to some by the lax Governmental administration of this measure, we refer to a recent article in the *Lumiere Electrique*, by M. Geraldy, as to an English patent for "Double-wound Dynamo Machines." By this statement M. Marcel Deprez, the eminent electrician, obtained a patent, dated 16th August, 1881, demonstrating that by the aid of "the concordant action of a constant current and of a variable current, a potential approximately constant may be obtained." He gave the method of measuring the approximation obtained, and indicated the various plans fit to realise this combination, and among them the employment of a derived current combined with the principal current.

Well, so far as M. Marcel Deprez is concerned, this is clear enough, but it would seem that a leading firm, on the 10th October, 1882, took out a similar patent for combined windings; yet, going over their method, without entering upon details here, we may justly feel that the security of their patent is not, in the words of M. Geraldy, "worth a farthing."

But this "double-winding" had become somewhat interesting to leading electricians, for we find a prominent company entering the arena for the chance of obtaining the prize, and on the 20th July, 1882, made an application, but withdrew in the month of October, because "they found, in the interval, that a similar arrangement had been put into practice in the year 1871 by Sinsteden and by others." The true reason for withdrawal was not that assigned, but another they had found out, namely, the existence of a prior patent, because Sinsteden's connection with this double-winding may be effectually disposed of as *nil*, by his own words in the *Poggendorf Annals*, Supplement V., pp. 651-653, May, 1871, and we therefore trust we may not hear a word more as an excuse for the piracy of this patent by the use of Sinsteden's honourable name. Now, giving some particular writers credit for sincerity of expression and disinterestedness on this subject, yet it is as easy to dispose of Mr. Brush's claim, if he ever made any himself, to any part of this principle of double winding as it is to dispose of that of the firm which advances Sinsteden's name, for we have only to refer to Mr. Brush's American patent of 22nd July, 1879, wherein the regulation of the current, the constancy of the potential, there is not one word, "nor did he seek them."

All this, however, is not by any means the last act of this "Comedy of Errors," relating to the patent for a double-winding electrical machine. When M. Marcel Deprez took out a patent in August, 1881, and when M. Geraldy wrote the leader now under discussion, it was doubtless in ignorance of the fact that the *bona fide* patentee of a double-winding machine was Dr. Paget Higgs, by his patent dated 5th May, 1881, for this country, and earlier for America; and his patent is consequently the only one valid, of which adequate notice has already publicly appeared.

Our Government, from this short history of one patent only, has manifestly made its obscurity in the Patent Office to pay well, by obtaining various sums from several for the same identical invention, without the most remote attempt to guide or protect.

Whether the new Patents Act is calculated to abstract more usurious sums from inventors without the institution of some rational system of protection we may, I suppose, soon learn from its operation.

W. M.

[W. M. has apparently written his letter hurriedly and somewhat confusedly, but, no doubt, his meaning will be clear.—EDS. ELEC. REV.]

Electrical Engineering.

Is there any prospect in Australia or new Zealand for an electrical engineer. I have a knowledge of the working of dynamos, lamps, and batteries, also steam engines and gas engines of the various makes. I would be content to take the lowest post in the business and work up. I have had a passion for this work all my life. Your answer or any information would be of value to

Progress.

26, Ormcaw Road, Belfast,
Sept. 10th., 1883.

[Probably our correspondent's letter will call forth some assistance by which he may be enabled to gratify his desires. At the present time the Colonies would be preferable, but we look forward to better things in England when the depression which now hangs over everything electrical has passed away.—EDS. ELEC. REV.]

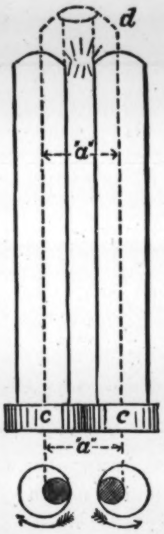
A Revolving Carbon Candle.

Herewith a sketch which may interest your readers, and perhaps by some of them be turned to a more practical account.

The dotted lines, *d*, represent an ordinary electric candle, and a section is given below.

The other parts represent elevation and section of carbons of double the diameter, separated by the same space as in the ordinary case, and mounted upon two toothed wheels, *c*, gearing into each other.

In the ordinary candle, the carbon is consumed as far back as distance, *a*, but by revolving the larger carbons (the rate being almost immaterial) every portion of the large carbons will of course have to traverse or come within the space occupied by the smaller or ordinary carbon, and therefore gradually consumed, but at a very much slower rate than has before been practicable in such systems; indeed, it would probably be found to last long enough to do away with duplicate candles and the number of wires, switches, &c., as well as the attendance at present necessary with these systems.



I am aware that no insulating material could well be kept between the carbons to prevent the travelling of the arc, but coating the carbons with hydrate of lime might perhaps be as good. The re-lighting by bringing the points together, and also the revolving mechanism, do not present to my mind any formidable difficulties.

I do not know whether I am the first to propose such an apparatus, and I have not had the time nor opportunity to investigate the matter.

C. Scott Snell.

St. Paul's Buildings, Paternoster Row,
Sept. 11th, 1883.

[Has Mr. Snell ever tried the effect of coating carbon rods with Asbestos paint?—EDS. ELEC. REV.]

The London and Provincial Electric Light Company.

Referring to your common-sense remarks on the London and Provincial Electric Light and Power Generating Company, I would be very glad to join any shareholders to compel the directors to return our monies, the fact having only just come to our knowledge that they proceeded to allotments upon a subscribed capital of £29,065 only and not £125,000, as promised in their prospectus, their contract having been broken by this breach of good faith and trust.

Trusting that immediate action will be taken.

D.

Sept. 10th, 1883.

PATERSON & [illegible]

(LATE EDWARD [illegible]

ELECTRIC LIGHT & POWER [illegible]

St. Paul's Works—76, LITTLE BRITAIN, LONDON, E.C., and
European Telegraph Works—POWNALL ROAD, DALSTON,

Prize Medals, International Electrical Exhibitions, Paris, 1881, and London, 1882.

MANUFACTURERS OF

THE ELPHINSTONE-VINCENT DYNAMO MACHINE.
THE LUMLEY DYNAMO MACHINE.
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